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South Dakota's Forest Resources Outside the Black Hills National Forest, 1996

Earl C. Leatherberry, Ronald J. Piva, and Gregory J. Josten

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This report includes the most commonly used U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis (FIA) statistics. Additional forest resource data can be obtained through FIA staff, through the use of an FIA Forest Inventory Tablemaker CD-ROM, or a table generator on the North Central Research Station's Internet page. Persons requesting special additional information from FIA staff are expected to pay the retrieval costs. Requests may be directed to:

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FOREWORD

Forest Inventory and Analysis (FIA) is a continuing endeavor mandated by the Renewable Resources Research Act of 1978. The objective of FIA is to periodically inventory the Nation's forest lands. Up-to-date resource information is essential to frame forest policies and programs. USDA Forest Service regional research stations are responsible for conducting these inventories. The North Central Research Station is responsible for inventorying Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin.

Fieldwork for the fourth South Dakota forest inventory was begun in 1995 and was completed in the spring of 1996. Results of the inventory are based on a sample of 363 forested plots and the modeling of 10 undisturbed-forested plots from the previous inventory. The reported statistics are estimates. The reader is cautioned to consult table 52 for sampling errors when using any data contained in this report. The USDI Bureau of Indian Affairs provided supplemental funding to collect data from additional plots on Indian lands. Fieldwork for the inventory was expedited through the cooperation and assistance of the South Dakota Department of Agriculture, Resource Conservation and Forestry Division. In addition, Division personnel surveyed primary forest products industries in South Dakota to determine current timber removals.

In the three previous inventories of South Dakota, the North Central Research Station inventoried only that portion of the State that is east of the 103rd meridian. The Intermountain Forest and Range Experiment Station in Ogden, Utah, inventoried the forest resources of western South Dakota (west of the 103rd meridian), including the Black Hills National Forest (BHNF). In the current inventory, the North Central Station inventoried all timberlands in South Dakota (including those west of the 103rd meridian), except the area inside the BHNF boundaries. Therefore, only limited information is presented about the forest resources of the BHNF. However, in the text we present tabular statistics of forest land area both outside and inside the BHNF. Those statistics are included to give readers information about the total area of forest land in the State. Also, some information on BHNF timber removals is contained in the statewide current annual removal estimates provided in tables 43-44 and 46, and in products removal tables 47-49. Finally, supplemental table 53 contains statistics of timberland area by forest type and stand-size class for the State, including the BHNF. However, other tables in the appendix that refer to "National Forest" pertain only to that portion of Custer National Forest that is in South Dakota. Readers needing more information about the forest resources of the BHNF should contact the Forest Supervisor's Office in Custer, South Dakota.

This report presents an analysis of the forest resources in South Dakota, outside of the BHNF, focusing primarily on the extent, condition, and status of forests. In the past, the east and west portions of the State, and the BHNF were not inventoried concurrently or with similar procedures, so we can make few comparisons between the 1996 inventory and previous inventories. For similar reasons, we do not make in-depth projections about the future direction of forest development in South Dakota.

Neal Kingsley (retired), FIA Program Manager, North Central Research Station, St. Paul, Minnesota, directed the fourth inventory of South Dakota. Gregory Josten, South Dakota Department of Agriculture, Division of Resource Conservation and Forestry, coordinated the State's responsibilities.

St. Paul FIA staff involved with the South Dakota forest resources inventory were Roger Audette, Gary Brand, Beth Collins, David Frazier, Barb Fuller, Dale Gormanson, Ron Hackett, Mark Hansen, David Haugen, Barb Johnson, Barb Knight, Troy Lindgren, Dennis May, Ron McRoberts, Pat Miles, Jerry Ostrom, Ron Piva, Gerhard Raile, Mary Jo Resendez, Tom Schmidt, Jay Solomakos, and Dan Wendt. FIA field staff members were John Benaszeski, Avery Beyer, John Crittenden, Gary Inhelder, Peter Koehler, Keith Magnusson, Mark Majewsky, Lisa McDonald, Tim Miller, Daniel Nelson, Wilfred Ortiz, Paul Perdew, Edward Reiss, Gary Stachowicz, Jerry Van Cleve, and Christopher Yonkers.

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South Dakota's Forest Resources Outside the Black Hills National Forest, 1996

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HIGHLIGHTS

Note: As we indicated in the Foreword, information in this report pertains largely to South Dakota's timberland outside of the Black Hills National Forest (BHNF). In 1996, there were 664 thousand acres of forest land[1] in South Dakota outside the BHNF. We estimate that the BHNF contains 959 thousand acres of forest land. Therefore, within South Dakota, there are an estimated 1.6 million acres of forest land. In the Appendix, supplemental table 53 provides estimates of timberland area by stand size class for the State, including the BHNF. Again, this report and the following highlights pertain to the forest outside of the BHNF.

- In addition to the 664 thousand acres of forest land in South Dakota outside the BHNF, there are 1.3 million acres of land with trees present. These areas include wooded strips, farm and field windbreaks, wooded pasture, abandoned cropland, and urban forests.
- Timberland accounts for 87 percent (575 thousand acres) of South Dakota's forest land area outside the BHNF.
- Eighty-five percent of South Dakota's timberland area outside the BHNF is privately owned. Timberland held in individual or joint ownerships accounts for nearly 60 percent of the timberland area. Native American tribal groups hold 16 percent and corporate owners hold 10 percent of the timberland area.
- People holding fewer than 50 acres of timberland owned 72 percent of all private timberland.
- South Dakota timberland is dominated by softwood stands. The ponderosa pine type occupies about half (290 thousand acres) of the timberland area but is mostly confined to the Black Hills region.
- Elm-ash-locust, with 82 thousand acres, is the most extensive hardwood forest type.
- Forty-two percent of the timberland area supports sawtimber-size stands.
- Twenty-two percent of the timberland area is capable of growing more than 50 cubic feet per acre per year.
- Growing-stock amounts to 432 million cubic feet. Ponderosa pine accounts for about two-thirds of the total growing-stock volume.
- On average, each acre of timberland has 752 cubic feet of growing stock. The cottonwood forest type far exceeds the average with 1,594 cubic feet per acre.
- In 1996, South Dakota's forest products industry employed more than 4,000 workers with a payroll of $76 million.

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[1] *See Definition of Terms in the Appendix for this and other terms used in the report.*

- In 1996, one in six households in South Dakota burned wood. Most of the wood came from dead trees; less than 2 percent was cut from the growing-stock portion of live timberland trees.

- Forests provide vital habitat for wildlife species. Wildlife that depends on forests for habitat contributes significantly to biological diversity. Expenditures related to wildlife observation and hunting provide economic benefits to local communities.

- Forests are sacred to Native Americans, who regard the pine-covered mountains of the Black Hills region as special ceremonial places.

INTRODUCTION

South Dakota is marked with geographic contrast—its terrain ranges from rolling in the east, to flat in the middle, to rugged badlands and mountains in the west. The climate is mostly semi-arid, characterized by wide seasonal temperature extremes. Most of the landscape is prairie or cropland. However, the character of the environment influences the growth and distribution of forests amid the prairie. Small tracts of scattered forest are present in the east where weather is sometimes influenced by moisture-laden air masses from the Gulf of Mexico. In the central portion of the State, trees are largely absent except along streams and in protected areas, such as narrow draws. Medium and short grasses, and shrubs are the predominant vegetation. In the west, the higher elevations of the Black Hills produce a montane climate that supports a developed forest.

Although South Dakota is mostly prairie and cropland, forests are important components of the landscape and play a prominent role in the State's history. The legacy of forests and trees in South Dakota is manifested in many ways. For instance, in eastern South Dakota, near Richland in Union County, a stately eastern cottonwood (*Populus deltoides*), the largest tree in the State, reminds all of its ability to withstand the ravages of nature and to not only survive, but thrive. In the central part of the State, an isolated grove of bur oaks (*Quercus macrocarpa*) has long stood on the prairie as a marker for travelers to gauge their passage. In the Black Hills, long-lived, dense stands of white spruce (*Picea glauca*)—the State Tree—are testimony of the longevity of South Dakota's forest.

South Dakota's forests have long endured; however, many concerns surround the resource. For instance, will reduced harvesting on public land lead to more harvesting on private land, and in the long term, affect forest sustainability? Will forest land conversion, especially to summer or year-round homesites in the Black Hills, lead to a timber supply shortage? Some academicians and professional foresters have wondered if residents of eastern South Dakota still share their ancestors' concern for the welfare and importance of trees (Schaefer *et al.* 1987).

At the dawn of a new millennium, the future of South Dakota's forest is unclear. As in the past, the State faces forestry challenges. To effectively meet the forestry challenges of the future, resource administrators and managers, and others need information that assesses the condition and status of the resource. We hope that the information in this report will serve as a basis of discussion from which informed decisions may result.

HISTORICAL OVERVIEW OF SOUTH DAKOTA'S FOREST

Presettlement Forest

Primeval forests covered much of present-day South Dakota. Evidence of prehistoric forests are found in fossilized remains of plants, skeletal remains of long-extinct vertebrates, and extensive areas of petrified forest—some dating back more than 100 million years (Schell 1968). In more recent geologic times, many significant events changed the character of the landscape and the climate of the region. In eastern South Dakota, continental glaciers created a highly variable landscape marked with lakes and thousands of small wetlands. West of the Missouri River, the landscape was shaped by erosion and weathering, creating a topography characterized by long and wide areas of flat land, intermixed with buttes, ridges, and rugged badlands. In the southwestern portion of the State, gigantic upheavals from within the Earth created the Black Hills. The same forces that created the Black Hills also created the Rocky Mountains to the west. The rising of the Rocky Mountains

helped form a prairie landscape by intercepting the flow of moist air from the Pacific Ocean, favoring the growth of grasses over trees. After the passing of the glacial period, around 10,000 years ago, a patchy coniferous forest covered parts of what is now eastern South Dakota (Wright 1970). A mix of boreal forest species, including spruce (*Picea* spp.), larch (*Larix* spp.) and jack pine (*Pinus banksiana*) extended into the western reaches of the region.

As the climate slowly became more seasonal and drier, boreal species were replaced by temperate deciduous species. In the east, along flowing streams, stands of cottonwood or other lowland hardwoods prevailed. Many of the lakes in the region had borders of trees. Groves of trees were scattered on the prairie. To the west, along the Missouri River floodplain, large groves of cottonwood, with clumps of American elm (*Ulmus americana*), hackberry (*Celtis occidentalis*), and green ash (*Fraxinus pennsylvanica*) flourished. West of the Missouri River, the tree resource was largely confined to river and stream floodplains. Mature green ash forests occurred along most of the larger drainage ways (Rumble *et al.* 1998). Throughout the prairie, scattered pockets of Rocky Mountain juniper (*Juniperus scopulorum*) and some eastern redcedar (*Juniperus virginiana)* were found in draws and gulches. In northwestern South Dakota, well-developed, mature cottonwood riparian forests were common along most of the larger streams (Rumble *et al.* 1998). In the Slim Buttes area, there were stands of green ash, ponderosa pine (*Pinus ponderosa*) and lodgepole pine (*Pinus contorta*). In the southwestern part of the State, the higher elevation and higher rainfall supported extensive stands of ponderosa pine, white spruce, and pockets of paper birch (*Betula papyrifera*) and quaking aspen (*Populus tremuloides*).

Settlement/Postsettlement Forest

The first settlers viewed forests and groves as special places. They often held council under the shade of a grove of trees. The Lakota Sioux called the pine-covered hills of western South Dakota, literally rising from the prairie, "paha sapa," which means "hills that are black" and regarded the forest as a place for spiritual awareness and renewal. To them, the Black Hills were a sanctuary where rival tribes met in peace for sacred ceremonies and hunting.

Throughout their period of dominion, Native Americans had a strong influence on forest resources. Their practice of burning the prairie to prepare for spring grazing by the American bison (*Bison bison*) and other ungulates limited the encroachment of woody vegetation into the prairie. A good prairie fire would destroy any emerging tree seedlings. In the Black Hills, fires that were set to drive game animals helped to maintain forests that were generally open, with park-like stands of ponderosa pine and aspen.

Europeans and Euro-Americans, whose numbers increased significantly in the late 19th century, brought about significant changes in the nature and extent of forest lands. In eastern South Dakota, for instance, settlements were built near groves of trees, and near rivers and streams. Those sites were desirable because the deciduous trees that grew there supplied much-needed lumber for constructing homes, barns, and fences, and they provided fuel. Along the Missouri River and its tributaries, forests provided valuable fuel for settlers and steamboats plying the river. In the Black Hills, the discovery of gold resulted in the indiscriminate logging of forested lands in the search for gold, mining timbers, and lumber to build towns and railroads. Later, forest fires resulted in the abandonment of many areas. In 1897, President Grover Cleveland established the Black Hills Forest Reserve, placing much of the larger forests of western South Dakota in public ownership.

Although the influx of white settlers brought change to the forests, not all changes were negative. Many settlers recognized the importance of trees and forests to life on the prairie. Many planted trees around their homes for beautification and windbreaks (Schell 1968). Government programs designed to encourage settlement of the Great Plains often had a tree-planting component. An example is the Timber Culture Act of 1873 that gave homesteaders 160 acres of land if they agreed to plant 40 acres of trees. In 1878, the Act was amended, and the number of acres to be planted was reduced from 40 to 10 (Ware 1936). Nearly all the plantations established in South Dakota under the Timber Culture Act

were east of the Missouri River. Adverse growing conditions, as well as lack of weed control and other maintenance resulted in the failure of many of the early tree plantings. When the Act was terminated after 18 years, only about 12 percent of the original plantations remained (Ware 1936). Tree planting was often undertaken without government incentives. For example, plantations established under the Timber Culture Act represented only one-third of all the plantations during the period in which it was enforced; the other two-thirds were begun by private initiatives (Ware 1936). Even today, some stands of trees can trace their beginnings to those early plantings by homesteading families.

During the first half of the 20th century, severe weather events set in motion major public works projects that had profound effects on forest lands. First, wind-induced erosion that produced the "Dust Bowl" days of the 1930's gave increased importance to the role of forests and trees in agrarian life on the prairie. Government-sponsored tree-planting programs were begun, such as the Prairie States Forestry Project, designed to facilitate dry land agriculture through the establishment of windbreaks, shelterbelts, and farm woodlots. Rows of various tree species including cottonwood, elm, Russian olive (*Elaeagnus angustifolia*), and eastern redcedar were set out in long east-west and north-south strips to break prairie winds and retard erosion. Since 1935, 176.6 million trees have been planted in rural South Dakota (Rumble *et al.* 1998). Second, seasonal flooding led Congress to pass the Flood Control Act of 1944 that authorized the construction of dams on the Missouri River. The Missouri River flows approximately 550 miles through South Dakota, and reservoirs behind four large dams inundated an estimated 140 thousand acres of bottomland forest along the Missouri River and its tributaries.

Forest resource inventories have been conducted in South Dakota since 1935 (Ware 1936, Choate and Spencer 1969, Green 1978, Collins and Green 1988, Raile 1984). However, reliable estimates of change in South Dakota's forest resources are difficult to obtain because of changes in inventory designs, methods, and definitions that have occurred with each succeeding inventory. Further complicating comparisons is the fact that two different FIA units have been responsible for inventorying South Dakota (see Foreword). Because sectional boundaries changed, and different designs and methods were employed, establishing trends and making comparisons is difficult. We can, however, surmise that the area of forest in South Dakota has remained fairly constant through most of the 20th century, periodically rising and falling, but hovering around 1.7 to 1.6 million acres. Over the years, forests were affected by human activities in contrasting ways, essentially offsetting losses in one region with gains in another region.

AREA OF FOREST LAND IN SOUTH DAKOTA—1996

The forest resources of South Dakota outside the BHNF are the focus of this report. First, however, we will briefly discuss forest land area from a statewide perspective to place the State's forest lands (those outside the BHNF and those inside the BHNF) in a spatial context. Statewide, there are an estimated 1.6 million acres of forest land in South Dakota, as shown in the tabulation below:

Forest Land Class	Outside BHNF	BHNF	State total
	(Thousand acres)		
Timberland	575.0	949.4	1,524.4
Reserved	12.2	9.8	22.0
Other forest	77.0	—	77.0
Total forest land	664.2	959.2	1,623.4

In the tabulation, forest lands are divided into three categories—timberland, reserved, and other forest (see Definition of Terms in the Appendix.) Timberland, the largest portion of forest land, accounts for nearly 9 of every 10 acres of forest land in the State. Most timberland is in the BHNF. Timberland outside of the BHNF totals 575 thousand acres. There are an estimated 22 thousand acres of reserved forest in South Dakota. The 9.8 thousand-acre Black Elk National Wilderness, established in 1980, is inside the BHNF. About 11.1 thousand acres of reserved forest is in western South Dakota in the Mount Rushmore National Memorial, Jewel Cave National Monument, and Wind Cave National Park. An estimated 1.1 thousand acres of reserved forest is located east of the Missouri River. An estimated 77 thousand acres of

forest land outside the BHNF are identified as other forest lands. Other forest lands are areas with trees that are not sufficiently productive to be classified as timberland because of adverse site conditions. Adverse site conditions in South Dakota include sterile or shallow soils, dry climate, steepness, and rockiness. Other forest lands have trees that are usually more widely spaced and of poor quality.

There are other lands with trees, but those lands do not have enough trees, or they have substantial development, or they are too narrow. Those lands are classified as nonforest land with trees. Lands typically in that classification include wooded strips, windbreaks, wooded pastures, and urban areas. Nonforest lands with trees are discussed later in this report.

TIMBERLAND AREA

Regional Distribution of Timberland

South Dakota's timberland outside of the BHNF is located in scattered pockets, in stringers along drainages, or in the Black Hills. The forests represent a transition from scattered hardwoods in the east to predominantly pure stands of ponderosa pine in the west. To portray the regional distribution of timberland, the State was divided into five river basin areas. The boundaries marking the five basins were juxtaposed based on the location of county boundaries and major rivers (fig. 1).

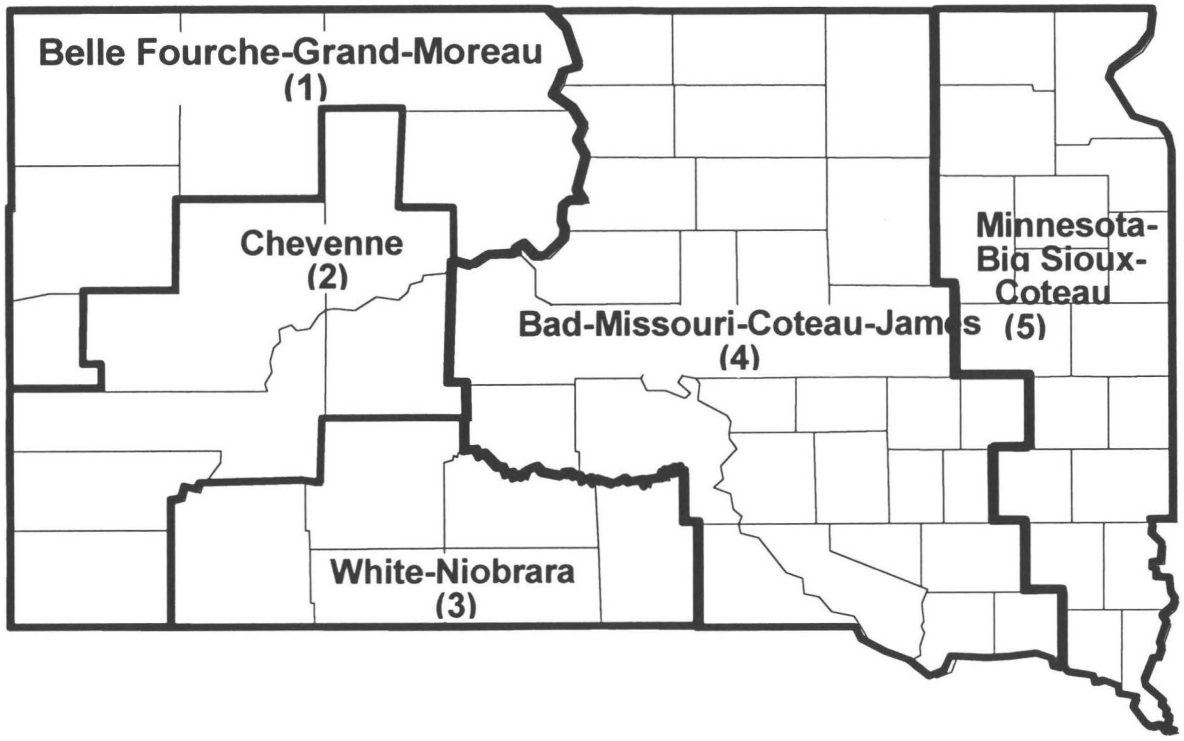

Figure 1.—*River basin areas, South Dakota, 1996.*

Although South Dakota is largely cropland and prairie, native tree communities exist where climatic, hydrologic, topographic, and edaphic factors combine to produce conditions where woody vegetation can grow. The regional distribution of timberland acres is shown in the tabulation at the bottom of this page.

The Cheyenne River basin contains more than 267 thousand acres of forest land, totaling about 4 percent of the basin's land area. The Cheyenne River basin area encompasses much of the Black Hills region. The 135 thousand acres of forest land in the Belle Fourche-Grand-Moreau basin area amounts to about 2 percent of the basin's land area. In the White-Niobrara basin, forest land is just over 1 percent of the land area. The western basins—the three west of the Missouri River—account for about three-fourths of the State's forest land that is outside the BHNF. Most of the forest land outside of the BHNF is classed as timberland. Land that is not as productive as timberland is referred to as other forest land, and is located in the western basins where soils are less productive and precipitation is lower.

In the eastern basins (Bad-Missouri-Coteau-James, and Minnesota-Big Sioux-Coteau), forest land occupies only about 1 percent of the land area. When combined, the two basins encompass about half the State's land area but only about one-fourth of the State's total forest land area outside the BHNF. Much of the land in eastern South Dakota is dedicated to agriculture about 9 of every 10 acres of cropland in South Dakota are located there.

TIMBERLAND OWNERSHIP

Private Owners Predominate

Most timberland outside the BHNF is privately owned. Nearly 6 (337 thousand acres) of every 10 acres of timberland are held in joint or individual ownerships (fig. 2). Corporate owners hold about 10 percent (55 thousand acres) of all timberland. Slightly more than two-thirds of all privately owned timberland is west of the Missouri River.

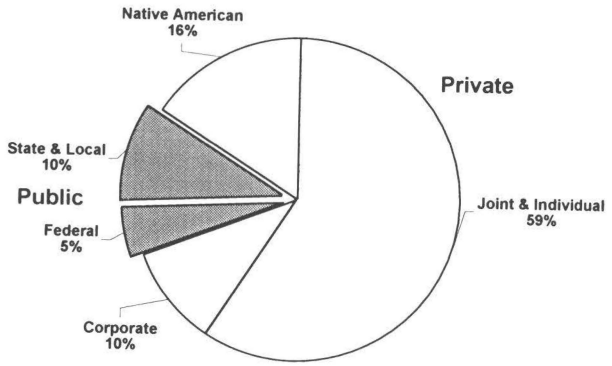

Figure 2.—*Timberland area by ownership class, South Dakota outside the BHNF, 1996.*

Native American tribal groups hold about 93 thousand acres of timberland—16 percent of the State's total timberland area outside the BHNF. Most Native American timberland is in Shannon County on the Pine Ridge Reservation.

In 1996, publicly owned timberland totaled 88 thousand acres, or 15 percent of the timberland outside BHNF. The State of South Dakota owns 54 thousand acres of timberland,

River Basin Area	Land Class			
	Timberland	Other forest	Reserve forest	Total forest
(Number-Name)	(Thousand acres)			
1 Belle Fourche-Grand-Moreau	130.0	5.1	—	135.1
2 Cheyenne	209.8	46.2	11.1	267.1
3 White-Niobrara	97.7	20.2	—	117.9
4 Bad-Missouri-Coteau-James	79.0	2.8	—	81.8
5 Minnesota-Big Sioux-Coteau	58.5	2.7	1.1	62.3
Total	575.0	77.0	12.2	664.2

much of it in Custer State Park in the Black Hills region. The Federal government holds 33 thousand acres of timberland outside the BHNF. Federally owned timberlands are in Custer National Forest, Buffalo Gap National Grassland, and around Missouri River water impoundment projects in eastern South Dakota.

Most Private Timberland is in Smaller Parcels

Privately owned timberland is held in parcels of varying size, but most holdings are 50 or fewer acres in size as shown in the tabulation below:

Size of holding (Acres)	Timberland area owned by private owners
	(Thousand acres)
1-10	74.5
11-20	83.7
21-50	124.8
51-100	48.2
101-500	44.6
501 +	16.7
Total	392.5

Those areas represent the total area of timberland held by an owner and may include one or more non-contiguous tracts of timberland. Virtually all (97 percent) of the timberland in holdings of 20 or fewer acres is held in joint or individual ownerships. Timberland in larger holdings, those over 100 acres, accounts for 16 percent of the privately owned timberland. Corporate owners tend to hold larger tracts of timberland. For instance, corporations owned 9 of every 10 acres of private timberland in holdings of more than 500 acres.

COMPOSITION OF SOUTH DAKOTA TIMBERLAND

South Dakota's timberland is comprised of a wide variety of tree species along with shrubs and understory vegetation. The species mix is the result of interactions between species and environmental factors including climate, hydrology, topography, and soil. To facilitate describing forest composition, the various tree species found in South Dakota are grouped into forest types that reflect the combinations of tree species that occur on a particular site. The classification is based on the species forming a plurality of live tree stocking on the site. On some sites, a single species may be dominant, such as ponderosa pine, while other sites contain a mix of species.

Softwood Forest Types Dominate

Forest types in which softwood species predominate occupy 55 percent of the timberland area in South Dakota outside the BHNF. The ponderosa pine forest type occupies fully half of all timberland area (fig. 3). The eastern redcedar and Rocky Mountain juniper forest types make up nearly all the remaining softwood forest. White spruce, a softwood species found in the Black Hills in pure stands at higher elevations, and in canyon bottoms, (Hoffman and Alexander 1987), is rare outside the BHNF.

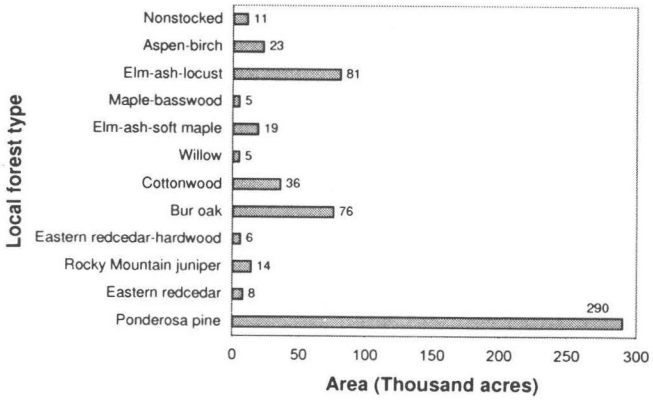

Figure 3.—*Area of timberland by forest type, South Dakota outside the BHNF, 1996.*

Ponderosa Pine Type Predominates

Ponderosa pines are ubiquitous in the Black Hills region, where they grow primarily in pure stands. The region, with its higher elevation, has the climatic and site conditions that permit ponderosa pine to thrive. In the past, an issue surrounding Black Hills' ponderosa pine was stocking control. Following harvest, overstocking of ponderosa pine seedlings was common (Green 1978). Currently, more acres of ponderosa pine are being actively managed to maximize timber production (fig. 4). There are outlying pockets of ponderosa pine in Shannon County on the Pine Ridge Indian Reservation, and in Harding County in the Slim Buttes area. Ponderosa pine is also found on the Rosebud Reservation in Todd County, and as far east as Turtle Butte in Tripp County.

Figure 4.—*This stand of ponderosa pine is representative of managed stands in the Black Hills region of South Dakota. (Photo courtesy of South Dakota Department of Agriculture, Resource Conservation and Forestry Division.)*

Eastern Redcedar Type Expands

Eastern redcedar has a significant presence on about 14 thousand acres, or about 2 percent of the State's timberland area outside the BHNF. Eastern redcedar is found in almost pure stands or intermixed with hardwoods. In the eastern redcedar-hardwood forest type, hardwoods represent most of the stocking, but eastern redcedar makes up between 25 and 50 percent of the total stocking. For this discussion, the eastern redcedar-hardwood forest type and the eastern redcedar type are combined and considered as eastern redcedar forests.

Eastern redcedar is expanding in South Dakota. For instance, in previous inventories of the State's forest resources, eastern redcedar was not present on enough acres to be classed as a forest type. What factors contributed to the expansion of eastern redcedar? Primarily changes in agriculture practice that reduced tillage, the abandonment of pastures, and in some areas overgrazing enabled eastern redcedar to expand into former agriculture lands. Another factor was the dispersal of seeds by birds as suggested by the appearance of seedlings along fencerows. Also, reduced burning of prairie grasses contributed to the expansion. The expansion of eastern redcedar in South Dakota follows the patterns observed in Nebraska (Schmidt and Wardle 1998) and Kansas (Leatherberry *et al.* 1999). The expansion has both positive and negative impacts. From a positive perspective, eastern redcedar provides wildlife habitat for species that rely on woody vegetation for their survival, increased species richness in areas where woody vegetation is limited, soil protection, and livestock protection. From a negative perspective, the expansion of eastern redcedar can make handling livestock more difficult, reduce forage production, and degrade native prairie (Schmidt and Wardle 1998).

Elm-Ash-Locust Most Extensive Hardwood Type

The elm-ash-locust type, with 82 thousand acres, is the most extensive hardwood forest type in South Dakota outside the BHNF (fig. 5). The elm-ash-locust forest resource is

found throughout the State, but primarily east of the Missouri River in the Bad-Missouri-Coteau-James basin area and in the Minnesota-Big Sioux-Coteau basin area. The predominance of the type throughout much of South Dakota is indicative of the adaptive capabilities of the species found in the type. For example, elm and green ash develop best on deep, rich, moist sites, but they also do well on dry sites or in areas where drought conditions are common. Native stands of green ash are found in scattered pockets in northwest South Dakota.

Bur Oak Type Widely Distributed

There are 76 thousand acres of timberland outside the BHNF in the bur oak type. Bur oak, the dominant species in the type, is the only native oak found throughout most of the State. It is a hardy species, able to withstand drought, and is one of the most drought resistant of the North American oaks (Johnson 1990). In eastern South Dakota, bur oak is found along stream bottomlands, adjacent draws, and upper slopes. In central South Dakota, where bur oak stretches onto the dry prairie uplands, the species has had a persistent presence. As an early successional species, bur oak is often the first tree to become established along prairie edges. It has persisted because of its thick, fire-resistant bark, which enabled it to survive repeated burning (Johnson 1990). In Lawrence and Custer Counties in the Black Hills region, stands of bur oak grow at low elevations between ponderosa pine stands and the grasslands.

Area of Cottonwood Type Declines

During the late 1800's, there were extensive stands of cottonwood in South Dakota, especially along the Missouri River and its tributaries (Rumble *et al.* 1998). In 1935, there were an estimated 94 thousand acres of land in the cottonwood forest type (Ware 1936). By 1996, land in the cottonwood type had declined to an estimated 36 thousand acres. Why has cottonwood, the fastest growing native tree in South Dakota, declined in area? Damming of the Missouri River and its tributaries contributed significantly to the decline of cottonwood. Before damming, the meandering river channels created thousands of

Figure 5.—*Species in the elm-ash-locust type occupy both upper slopes and bottomlands. This area is located in Haakon County. (Photo courtesy of South Dakota Department of Agriculture, Resource Conservation and Forestry Division.)*

acres of sites suitable for cottonwood regeneration. Flooding would create moist, sandy soil sites that were exposed to the sun—ideal conditions for germination of cottonwood seeds. Dam construction permanently inundated thousands of acres of alluvial bottomlands and reduced the lateral movement of channels during flooding. Without floods, few new habitats for cottonwood were created. As a shade intolerant species, cottonwood seedlings generally are not a component of the understory vegetation of mature cottonwood stands. Over time, as cottonwood trees mature and die, other species such as eastern redcedar, green ash, hackberry, and box elder (*Acer negundo*) dominate the stand. This process is occurring in many cottonwood stands in South Dakota.

Aspen-Birch Type Confined to Black Hills Region

The aspen-birch forest type, a type commonly associated with boreal forest, is found generally in small stands in Lawrence, Pennington, and Custer Counties in western South Dakota. There are an estimated 23 thousand acres of forest in the aspen-birch type. The aspen-birch resource is scattered in small patches and is not available in sufficient quantities for commercial harvesting (fig. 6). The aspen-birch type is similar in several ways to the cottonwood type in the eastern part of the State. Both are shade intolerant, grow in nearly pure stands, and without disturbance, have difficulty regenerating.

Other Hardwood Types

Other hardwood forest types in South Dakota are elm-ash-soft maple—19 thousand acres; maple-basswood—5 thousand acres; and willow (*Salix* spp.)—5 thousand acres. The elm-ash-soft maple forest type is generally considered a lowland/riparian forest type and is commonly found along rivers and streams. The elm-ash-soft maple type is a companion forest type with elm-ash-locust. Both forest types have common species, primarily elm, green ash, and hackberry. The willow forest type is a lowland/riparian forest type and often occurs with the cottonwood type.

Figure 6.—*Black Hills aspen, in the foreground, is often associated with ponderosa pine, and in fall it provides a contrasting backdrop to the evergreens. (Photo courtesy of South Dakota Department of Agriculture, Resource Conservation and Forestry Division.)*

Nonstocked Timberland

In 1996, there were 11 thousand acres of nonstocked timberland in South Dakota. Nonstocked timberland is land that has forest as its primary land-use but that did not have a sufficient number of trees present during the 1996 inventory to be classified into a forest type. Forested stands that were harvested recently and that have not had sufficient time to regenerate are an example of nonstocked timberlands. Eighty-three percent of the nonstocked timberland is in the southwestern corner of the State. Those nonstocked timberlands are probably sites where ponderosa pine had been recently harvested or burned. It is expected that those sites will revert back to ponderosa pine through natural regeneration. Regeneration of ponderosa pine has not been a problem in the past because of the frequent heavy seed crops, combined with timely and abundant spring and summer precipitation (Boldt and Van Deusen 1974). Some of the nonstocked timberland may not revert to forest because it was in the process of being converted to home sites or other development, or it was being converted to rangeland for use by livestock.

STRUCTURE OF SOUTH DAKOTA TIMBERLAND

Sawtimber-Size Stands Predominate

Stand-size class is a measure of the average diameter of the dominant trees in a stand. It reflects the size structure of stands over an area. There are three stand-size classes: sawtimber—large trees; poletimber—medium trees; and sapling/seedling—small trees. In South Dakota, outside of the BHNF, 42 percent (239 thousand acres) of the timberland area is classified as sawtimber stands (fig. 7). Sapling/seedling-size stands account for 34 percent of the timberland area, followed by poletimber-size stands with 22 percent of the timberland area. About 2 percent of the timberland area is classed as nonstocked.

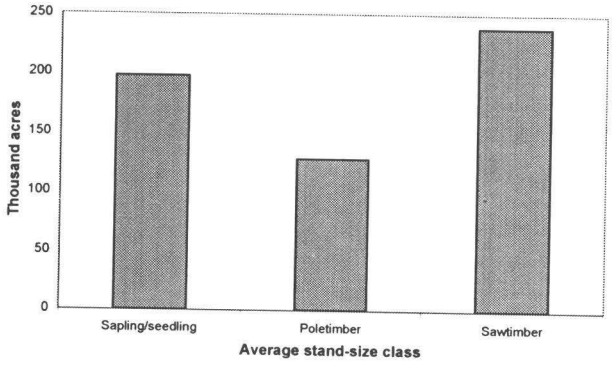

Figure 7.—*Average stand-size class for timberland in South Dakota outside the BHNF, 1996.*

Stand Age

Timberland stands in South Dakota can be grouped into three broad age categories: young stands—1 to 40 years old, mature stands—41 to 100 years, and old stands—more than 100 years old. Mature stands occupy 71 percent of the timberland area, followed by young stands at 23 percent, and old stands at 6 percent of the timberland area. The largest area of timberland is in the 61- to 80-year-old age class with 181 thousand acres (fig. 8). The high proportion of stand area in the mature age class indicates that many stands came into existence during the 1930's or earlier. In eastern South Dakota, many of those stands were planted as large windbreaks and are now entering a period of decline. Without replanting or renovation, those stands will begin to break up. Also, many of the mature native hardwood stands are undergoing structural and compositional change.

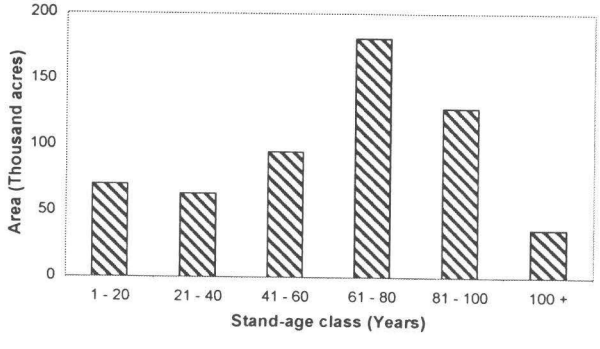

Figure 8.—*Timberland area by stand-age class, South Dakota outside the BHNF, 1996.*

Stand age varies by forest type. Old forest stands are primarily in the ponderosa pine, Rocky Mountain juniper, and cottonwood forest types. Of the 36 thousand acres of timberland that are in stands older than 100 years, 58 percent of the area is in the ponderosa pine type, followed by the Rocky Mountain juniper type with 20 percent, and the cottonwood forest type with 12 percent of the area. Stands in the eastern redcedar and willow types are virtually all under 40 years of age. Other types with a relatively high percentage of area in young stands are elm-ash-locust—40 percent; and elm-ash-soft maple and aspen-birch each with about 35 percent of their areas in young stands.

In general, South Dakota's timberland stands are trending toward old age. Ponderosa pine and bur oak tend to grow to older ages. For instance, it can take Black Hills ponderosa pine more than 100 years to grow to a size suitable for use as commercial lumber. In the 1996 inventory, ponderosa pine, cottonwood, and bur oak had proportionally more acres in the older age classes (over 40 years) than did other forest types. Nearly 9 out of every 10 acres in the ponderosa pine type supported stands that were 40 years or older. About 8 out of every 10 acres in the cottonwood and bur oak types supported stands that were 40 years or older.

Number of Trees

There are an estimated 221 million live trees larger than 1 inch in diameter at breast height (d.b.h.) on South Dakota's timberland outside the BHNF. On average, every acre of timberland has about 385 trees growing on it. Ponderosa pine accounts for 51 percent of all trees. Three other species, in combination, account for one-fifth of all trees: bur oak—8 percent, green ash—7 percent, and elms—6 percent. Although sawtimber-size stands predominate, individual trees tend to be small. The majority of trees (67 percent) are under 5 inches d.b.h. However, large trees are relatively common. For instance, in the western part of the State, stands of ponderosa pines that have diameters larger than 25 inches at breast height are not uncommon. In eastern South Dakota, most commonly in riparian areas, stands with large cottonwoods dominate the landscape—some with diameters larger that 40 inches. Scattered over the landscape, in smaller numbers, are large box elder, bur oak, and silver maple (*Acer saccharinum*) trees.

Live trees are classed as either growing-stock trees or non-growing-stock trees. To qualify as a growing-stock tree, the tree must have the capability to produce one 12-foot log or two 8-foot logs with additional criteria placed on the quality of the log (see Definition of Terms in the Appendix for additional details). Non-growing-stock trees consist of non-commercial species such as eastern hophornbeam (*Ostrya virginiana*), and peachleaf willow (*Salix amygdaloides*) as well as rough and rotten trees of commercial species. The primary reason a tree is classed as a non-growing-stock tree is small size, poor form, or inferior quality making it unsuitable for industrial wood products. An estimated 19 percent of the trees are considered non-growing-stock trees. Whether a tree is classed as growing stock or non-growing stock has little to do with its ecological or social value, especially in eastern South Dakota where trees are relatively scarce.

Factors That Influence Stand Structure and Species Mix

South Dakota's forests are constantly changing. The rate of change is often slow, influenced by available light, water, and soil nutrients, and tree species' ability to use those resources. Disturbances can accelerate change by disrupting biotic interactions and resource availability. Across South Dakota, several different events, both natural and human caused, influence the structure and mix of species on the landscape. For example, eastern redcedar is a species that is expanding in South Dakota. As a pioneer species, it has become established on grassland and abandoned range and farmland. As a result, most stands—86 percent—with a predominance of eastern redcedar are in the sapling/seedling-size stand class. The situation is different with cottonwood, a shade intolerant species that occurs mostly on bottomland sites. Larger trees are dominant in cottonwood stands. More than 90 percent of the acreage in the cottonwood forest type supports sawtimber-size trees. Cottonwood is in a stage of transition in South Dakota. As discussed previously, environmental changes brought about through damming of rivers have resulted in a decline of the species. The rate of decline is largely dependent on how long

existing cottonwoods live because underneath the large cottonwoods, other species are waiting to be released.

The aspen-birch forest type in western South Dakota has been maintained through periodic disturbances, generally fire. Fires set by Native Americans or caused by lightning burned the area at frequent intervals and stimulated the vegetative regeneration of aspen by root suckering. Fire also reduced competition from ponderosa pine and white spruce. Today, however, the aspen resource in the Black Hills region appears to be at a crossroads because disturbances are relatively rare. For instance, fires occur less frequently than in the past, and are often controlled or suppressed. Also, few aspen stands are harvested. In other areas throughout the Western United States, communities of aspen are deteriorating (Kay 1997). Does that fate await South Dakota aspen? Current evidence suggests that aspen in the Black Hills region is holding on and indeed may be slightly expanding. Apparently, aspen regeneration without disturbance has been successful. We found that aspen exist in essentially stable communities. Most aspen is in nearly pure stands. As those stands mature, become decadent, and die, young aspen will probably fill the openings that will be created. The substantial acreage of aspen-birch forest type in the small size class reflects the process of natural regeneration (fig. 9).

In some places in South Dakota, especially on the high prairie, the severity of the weather and the constant wind restrict the growth potential of tree species. In those situations, trees may be relatively old, yet small in size. This is common among species that make up the bur oak forest type, where in the 1996 inventory more than 75 percent of the area in the type was over 40 years old, but 54 percent of the area supported sapling/seedling-size stands. The relative high percentage of bur oak acreage in the small size class reflects the ability of species in the type to occupy and

Figure 9.—*This aspen sapling stand in the Black Hills region is an example of the small scattered nature of the aspen resource in South Dakota. (Photo courtesy of South Dakota Department of Agriculture, Resource Conservation and Forestry Division.)*

dominate on drier sites. In many places in South Dakota, the first trees to become established are hardwoods, and they can effectively resist the invasion of other species. In some areas, where summer moisture stress is more extreme, the type tends to form stable communities (Parker and Merritt 1994).

The ponderosa pine resource in the Black Hills region outside the BHNF is mostly a second-growth forest. Persistent harvesting, coupled with the destructive impacts of livestock overgrazing, wildfire, and insect and disease outbreaks, eliminated much of the original forest (Boldt and Van Deusen 1974). The containment and suppression of wildfire has led to a population explosion of ponderosa pine. Following harvesting or other stand disturbances, ponderosa pine generally reoccupies the site. Because of favorable and timely precipitation, high stand densities are common in naturally regenerated stands. For example, about two-thirds of the ponderosa pine trees have a d.b.h. of 5 inches or smaller (fig 10).

TIMBERLAND PRODUCTIVITY

Potential Productivity

Just how productive is South Dakota timberland? The capacity of timberland to grow wood can be assessed by estimating cubic feet of growth per acre per year at the culmination of mean annual increment of a fully stocked natural stand. Potential productivity of a stand is related to the site's inherent capacity to grow trees and generally does not change over time. In 1996, 22 percent of the timberland in South Dakota outside the BHNF had a potential productivity of more than 50 cubic feet per acre per year as shown in the tabulation on the next page.

Figure 10.—*Overstocked "doghair" ponderosa pine stands often become stagnant and remain so for years if not thinned. (Photo courtesy of South Dakota Department of Agriculture, Resource Conservation and Forestry Division.)*

River Basin Area	Potential productivity class, cubic ft. of growth/acre/year	
	>50	<50
(Number-Name)	(Percent of timberland)	
1 Belle Fourche-Grand-Moreau	26	74
2 Cheyenne	11	89
3 White Niobrara	14	86
4 Bad-Missouri-Coteau-James	37	63
5 Minnesota-Big Sioux-Coteau	48	52
Total	22	78

In general, timberland in the two eastern river basins (numbers 4 and 5) have higher productivity, which is indicative of the more productive soils and more favorable growing conditions in that part of the State. For example, the few hundred acres of timberland that have a potential productive capacity of over 120 cubic feet supported poletimber-size stands in the eastern redcedar forest type. Eastern redcedar was planted extensively in many of the larger windbreaks in the region. Also, as a pioneer species, eastern redcedar is likely to invade abandoned agriculture fields and pastures—sites that tend to be more productive. In the western part of the State, ponderosa pine tends to occupy the more productive sites. Also, stands in the cottonwood and willow forest types, which typically grow on bottomland sites, tend to occupy the more productive sites. For instance, the timberland rated as having a site index of greater than 80, which is considered excellent in terms of productivity, supports stands of cottonwood and willow. It should be pointed out that the most productive soils in the State are either in crop production or pasture.

Stocking Levels

Stocking, a measure of how well the land is occupied by trees, is typically measured by basal area. If timberland is held for wood fiber production, maximum production is gained from fully stocked stands. In South Dakota outside the BHNF, only 17 percent (97 thousand acres) of the timberland is fully stocked. The majority (51 percent or 295 thousand acres) of timberland is poorly stocked. Stands that are poorly stocked tend to be in eastern and central South Dakota. Those basins—White-Niobrara; Bad-Missouri-Coteau-James; and Minnesota-Big Sioux-Coteau—have proportionally more timberland (greater than the State's average) that is poorly stocked.

We pointed out earlier that timberland in the two river basins east of the Missouri River has higher potential productivity than in those to the west. However, the lower stocking levels in the region point to less emphasis placed on timber management. Conversely, the higher stocking levels associated with stands in western South Dakota are indicative of the ability of ponderosa pine to fully occupy sites, and may suggest that more timber management occurs in the region than in other parts of the State.

TIMBERLAND VOLUME

The amount of woody vegetative material on forest land is an indicator of productivity and complexity. In this report we use several different measures to assess the volume of woody material present on forest land. Volume is presented for growing-stock trees, sawtimber, non-growing-stock trees, and biomass. Growing-stock volume is the volume of wood on timberland in growing-stock trees at least 5 inches d.b.h., from 1 foot above the ground to a top diameter outside bark (d.o.b.) of 4 inches, less rot and other defects that reduce the yield for forest products. Sawtimber volume is a subset of growing-stock volume and is the volume of wood on timberland in trees from the stump to a minimum 9 inches top d.o.b. for softwoods and 11 inches d.o.b. for hardwood species. Non-growing-stock volume is the volume of wood that is either rotten, rough, has poor form, or is present only in short logs. Biomass is the aboveground volume of all live trees and is measured in green tons.

Growing-Stock Volume

The volume of growing stock on timberland in South Dakota outside of the BHNF totals 432 million cubic feet. Ponderosa pine accounts

for about two-thirds of the growing-stock volume. Ninety-two percent of the growing-stock volume is contained in four species: ponderosa pine—63 percent; cottonwood—18 percent; green ash-6 percent; and bur oak—5 percent (fig. 11).

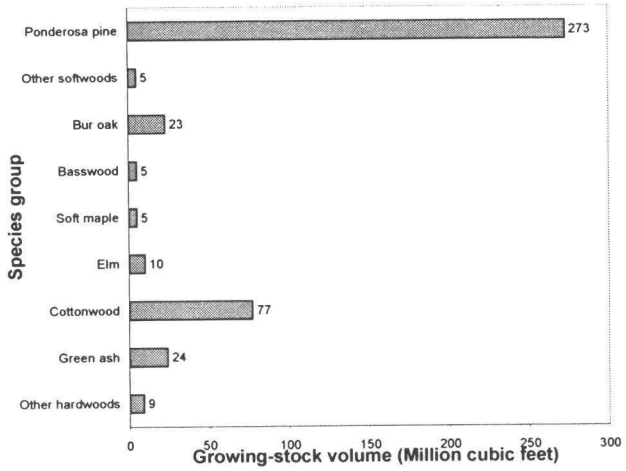

Figure 11.—*Growing-stock volume by species group, South Dakota outside the BHNF, 1996.*

Cottonwood growing-stock volume is contained in large diameter trees; 63 percent of the cottonwood growing-stock is contained in trees that are 21 inches d.b.h. or larger. Conversely, more than half of the growing-stock volume in ponderosa pine (57 percent), green ash (63 percent), and bur oak (73 percent) is contained in trees that are 13 inches d.b.h. or smaller.

The vast majority (86 percent) of total growing-stock volume is in stands older than 50 years old. Ninety-three percent of the growing-stock volume in the ponderosa pine type is in stands older than 50 years. Eighty-three percent of the cottonwood growing-stock volume is in stands older than 50 years old. Nearly 10 percent of total growing-stock volume is in stands more than 100 years old. Almost 20 percent of the growing-stock volume in the cottonwood type is in stands older than 100 years, which is further evidence of the continuing maturation of South Dakota's cottonwood stands.

Growing-stock volume per acre on timberland across South Dakota averages 758 cubic feet. Volume per acre in South Dakota compares favorably with adjoining Plains States. In 1994, Nebraska averaged 915 cubic feet per acre (Schmidt and Wardle 1998), and North Dakota averaged 727 cubic feet per acre of growing-stock volume (Haugen *et al.* 1999). However, volume per acre varies widely between river basins in South Dakota as shown in the tabulation below:

River Basin Area (Number-Name)	Cubic feet/acre of growing stock
1 Belle Fourche-Grand-Moreau	954
2 Cheyenne	721
3 White-Niobrara	655
4 Bad-Missouri-Coteau-James	473
5 Minnesota-Big Sioux-Coteau	951
State average	758

In much of western South Dakota, (river basins 1 and 2) growing-stock volume per acre exceeded the State's average in the 1996 inventory. In the drier central region, (river basins 3 and 4) volume per acre of growing-stock was substantially below the statewide average, and in eastern South Dakota (river basin 5) volume per acre was comparable to that found in much of western South Dakota (river basin 1).

Analysis of the growing-stock volume by forest type reveals that the cottonwood type, with an average of 1,600 cubic feet per acre, exceeds by a large margin, the per acre volume of trees in the other forest types found in South Dakota (fig. 12).

In addition to cottonwood, the maple-basswood, elm-ash-soft maple, and, ponderosa pine forest types exceed the State's average growing-stock volume of 758 cubic feet per acre. The dominant species in those types, except for ponderosa pine, are often found in riparian forest areas. Riparian areas, and the montane climate found in the Black Hills region, are more conducive to tree growth than the semi-arid climate common to the plains of South Dakota.

Sawtimber Volume

Total sawtimber volume in South Dakota outside the BHNF is 1.6 billion board feet. Ponderosa pine accounts for slightly more than two-thirds (1 billion board feet) of the total sawtimber volume. Cottonwood accounts for nearly a fifth (355 million board feet).

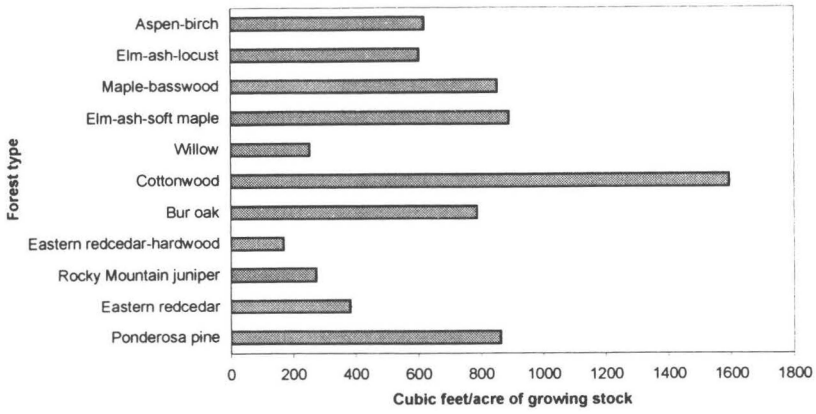

Figure 12.—*Average growing-stock volume per acre by forest type, South Dakota outside the BHNF, 1996.*

Combined, ponderosa pine and cottonwood account for 87 percent of the sawtimber volume. Most (66 percent) of the ponderosa pine sawtimber volume is in the 11- to 19-inch diameter class. Most (69 percent) of the cottonwood sawtimber volume is in trees larger than 21 inches d.b.h.

Quality of the Sawtimber Volume

Sawtimber tree quality was assessed by the field staff as they assigned a log grade to softwood sawtimber-size trees and a tree grade to hardwood sawtimber-size trees on about one-third of the sampled plots. The four grades used were based on tree diameter and the presence or absence of knots, decay, crookedness of the bole, or other external characteristics in the lowest log of the tree. The relative prevalence of these characteristics reflects the quality of the tree for manufacturing into wood products. The most critical element in determining log grade or tree grade is the d.b.h. of the tree. Smaller diameter trees tend to be assigned to the lower grades. In the analysis of sawtimber quality data, grade 1 represents the highest quality and grade 4 represents the lowest quality.

In South Dakota, outside the BHNF, 13 percent of the sawtimber is in grade 1, 11 percent in grade 2, 70 percent in grade 3, and 6 percent is in grade 4. As noted previously, almost 90 percent of total sawtimber volume are in two species: ponderosa pine (64 percent) and cottonwood (23 percent), which differ in quality. In the inventory, only 10 percent of the ponderosa pine sawtimber was rated as log grades 1 and 2 compared to 63 percent of cottonwood sawtimber volume in grades 1 and 2. The lower average grades for ponderosa pine are due mostly to smaller average diameters and greater rates of taper. Silver maple accounted for only 4 percent of the sawtimber volume, but 59 percent of that volume was rated as log grade 1. No other species had significant volume in the higher grades.

Non-Growing-Stock Volume

In a typical forest stand, trees are in varying stages of growth or development. Generally, most of the stand is well developed and growing. However, some trees in the stand are dead or dying, some have rot, some have defects because of roughness or poor form, and some are too short for most commercial uses. The volume of wood in such trees is referred to as non-growing-stock volume. The tabulation below shows the volume of wood in non-growing-stock trees in South Dakota outside the BHNF:

Tree form	Non-growing-stock volume
	(Thousand cubic feet)
Short-log trees	28,283
Rough trees	82,691
Rotten trees	15,615
Salvable dead trees	8,377
Total	134,966

Non-growing-stock volume is an important source of fuelwood and wood for agricultural use, such as fence posts. Also, non-growing-stock volume trees are important resources that contribute to wildlife species diversity.

Many of the non-growing-stock trees are preferred nesting sites for cavity nesting birds, or dens for mammals such as raccoon (*Procyon lotor*). Many rotten or dead trees are infested with wood-dwelling insects and provide foraging sites for insectivorous birds.

Biomass

Aboveground biomass of all live trees at least 1 inch d.b.h. amounts to nearly 23 million green tons (weight of live, green trees), or an average of 41 green tons per acre. The ponderosa pine forest type accounts for 9.4 million green tons, 42 percent of the total; followed by elm-ash-locust with 4 million green tons (18 percent); bur oak with 3.3 million green tons (15 percent); and cottonwood with 2.8 million tons (12 percent).

Stands in the cottonwood forest type contain the most biomass per acre—79 green tons. The maple-basswood type follows with 66 green tons per acre, ahead of the elm-ash-soft maple (60 tons), the elm-ash-locust (50 tons), and the bur oak (44 tons). The ponderosa pine type has 33 green tons per acre. The least biomass per acre is in the Rocky Mountain juniper type (22 tons) and the aspen-birch type (28 tons).

The greatest share of live tree biomass is in the boles of growing-stock trees (52 percent or 11.9 million green tons). Growing-stock tops and limbs account for 9 percent (2.1 million green tons) of all biomass, and stumps account for 5 percent (1.1 million green tons). Twenty-six percent of biomass (5.9 million green tons) is in non-growing-stock trees. Nearly 8 percent of all live tree biomass (1.7 million green tons) is in trees from 1 to 5 inches d.b.h.

TIMBER GROWTH

Growth is measured in cubic feet for growing stock and board feet for sawtimber and is expressed as average annual net growth and current annual net growth for both. Current annual net growth is useful for comparing growth during two distinct years, but neither of the 2 years may represent average conditions. Net growth may fluctuate from year to year because of weather changes or catastrophic mortality. Net growth averaged over the period between the two most recent inventories (periodic growth) will even out these fluctuations and therefore may provide a more useful comparison. For the 1996 inventory, average annual growth was computed for the period 1980-1995 in eastern South Dakota and for 1984-1995 in western South Dakota except the area inside the BHNF. Current annual growth is based on growth in 1995. In the Appendix tables, both average annual and current annual growths are net growth. Net growth is gross growth minus mortality.

Growing-Stock Growth

Between inventories, an average of 7.9 million cubic feet of net growth of growing stock was added each year to timberland stands in South Dakota outside of the BHNF. That is an average of about 14 cubic feet of net growth per acre per year between inventories. The average annual net growth rate of growing stock of 7.9 million cubic feet represents about 1.8 percent of the growing-stock volume. On a per acre basis, the cottonwood forest type has the greatest average annual net growth rate with 29 cubic feet per acre, followed by aspen-birch with 20 cubic feet per acre, and ponderosa pine and bur oak each with 13 cubic feet per acre. In terms of total growth, ponderosa pine, the predominant tree species in South Dakota, accounts for about half (52 percent) of the average annual net growth of growing stock. More than 80 percent of the average annual net growth occurs within four species—ponderosa pine (52 percent), cottonwood (15 percent), green ash (9 percent), and bur oak (8 percent).

Growing-stock current annual net growth was 7.8 million cubic feet in 1995. Current growth can only be compared with periodic growth in a general way. However, the current annual net growth rate (7.8 million cubic feet) suggests that growth probably occurred at a relatively constant rate over the recent past.

Sawtimber Growth

Between inventories, timberland outside the BHNF averaged 33 million board feet of growth per year. On a per acre basis, 58 board feet of growth was added each year between periods on timberlands. The ponderosa pines accounted for 65 percent of the average annual net growth of sawtimber, followed by cottonwood (15 percent), and green ash (7 percent). In 1995, sawtimber current annual net growth was nearly 36 million board feet.

TIMBER MORTALITY

Tree mortality played a role in changing South Dakota's timberland resource. Like average annual growth, mortality was computed from the dates of inventories in eastern and western South Dakota to 1995. Between inventories, growing-stock mortality averaged 4.5 million cubic feet per year. Sawtimber average annual mortality during the same period amounted to 13 million board feet per year. In 1995, the mortality rate (current annual mortality) for growing-stock volume was 4.6 million cubic feet or about 1.0 percent of growing-stock volume. Current annual sawtimber mortality is 16.2 million cubic feet, amounting to 0.8 percent of sawtimber volume.

Approximately 80 percent of the current annual growing-stock mortality is confined to three species: ponderosa pine (1.7 million cubic feet), cottonwood (1.3 million cubic feet), and elm (0.6 million cubic feet). Current annual growing-stock mortality in ponderosa pine amounts to 0.6 percent of growing-stock volume, less than the statewide average for all species. On the other hand, current annual growing-stock mortality for elm and cottonwood exceeds the rate for all species. Current mortality for elm is 6 percent of growing-stock volume. For cottonwood, current mortality amounts to 2 percent of volume. American elm has been especially hard hit by Dutch elm disease, and Siberian elm is succumbing to old age. Also, cottonwood is generally succumbing to old age.

Many different agents or events can lead to mortality. Often it is difficult to assign a cause of death, especially after several years have past. In terms of known causes, stem decay is the predominate cause of death, accounting for 5 percent of average annual mortality of growing-stock volume. Stem decay as a cause of death is largely confined to cottonwood trees, pointing to the predominance of old cottonwood trees. Mechanical damage accounts for 4 percent of the growing-stock mortality. Mechanical damage as a cause of death is largely in ponderosa pine stands due to harvesting. Eighty-two percent of the average annual mortality of growing-stock volume due to mechanical damage is in ponderosa pine stands. Decline or dieback accounts for 10 percent of average annual mortality. Elm and cottonwood suffer most from decline or dieback. Mortality from fire (49 thousand cubic feet) is confined to ponderosa pine stands. Occasionally, large-scale wildfire breaks out in the region. For example, in 1988, a lightning-caused fire in the vicinity of Custer State Park and Mount Rushmore burned 16,000 acres of forest land.

Mortality in planted windbreaks is of special concern to forestry officials and others (Schaefer *et al.* 1987). Severe ice storms and the record snow fall and blizzard conditions of 1996-1997 caused extensive damage to tree plantings. In 1997, foresters from the South Dakota Resource Conservation and Forestry Division surveyed 45 windbreaks across the northern two-thirds of the State to assess damages. Josten and Rasmuson (1997) found that renovation work was needed in 87 percent of the windbreaks surveyed. They concluded that although many windbreaks were not completely destroyed, the damage done would probably hasten their demise unless action was taken to rehabilitate them through renovation.

TIMBER REMOVALS

In 1996, growing-stock removals from timberland totaled 17 million cubic feet, including timber from the Black Hills National Forest (fig. 13). Sawtimber removals totaled 87 million board feet. Ponderosa pine volume accounted for 92 percent of the growing-stock volume removals. The only other significant removals were of cottonwood, which amounted to 788 thousand cubic feet or 5 percent of total timber removals in the State.

Nearly all—96 percent—of the growing-stock removals were from timberland in the West Unit. Softwoods, primarily ponderosa pine, from the West Unit accounted for 16 million cubic feet or 92 percent of the State's total timber removals.

Timber Removals for Commercial Products

South Dakota's history of timber harvest for commercial products dates back to1899, when the first sale of timber on Federal land was made in the Black Hills (Ware 1936). There are 18 primary wood-using industrial facilities in South Dakota (Hackett and Sowers 1996). Twelve are sawmills, and six are post and pole

Figure 13.—*Removals represent one of the causes of change in South Dakota's forests. Harvesting operations, such as shown here, play an important role in the economy of the Black Hills region. (Photo courtesy of South Dakota Department of Agriculture, Resource and Forestry Division.)*

mills, log cabin manufacturers, or pulp mills. All but five of the facilities are located in the Black Hills region, which is the regional hub for ponderosa pine harvesting and processing activity (May 1996a). The primary wood-using mills in South Dakota process nearly 19 million cubic feet of wood volume into lumber and other products. Timber removals that are converted to commercial products come from both growing-stock and non-growing-stock volume. Growing-stock volume from timberland accounts for 73 percent (14 million cubic feet) of the volume of wood used for wood products. The bulk of non-growing-stock volume is used as fuelwood, which is discussed below. Saw-log production accounts for 70 percent (13 million cubic feet or 79 million board feet) of timber that is removed for products. Virtually all saw logs cut are ponderosa pine, with some cottonwood. Only 4 percent (810 thousand cubic feet) of timber removals are processed into composite products such as chip board, wafer board, particleboard, and engineered lumber. Timber volume used for producing posts, poles, and pilings totals 67 thousand cubic feet. The majority (51 thousand cubic feet) of volume of wood used for posts, poles, and pilings came from non-growing-stock volume and most of that is ash.

Timber Removals for Fuelwood

About one in six households burns wood in South Dakota (May 1996b). Timber removals for fuelwood amount to 68 thousand cords. Four species—elm, ash, cottonwood, and ponderosa pine—account for nearly all of the volume of wood used as fuelwood. Nearly all of the wood burned as fuelwood comes from dead trees. Less than 2 percent of all fuelwood produced was cut from growing-stock portions of live timberland trees. As a consequence, fuelwood removals have minimal impact on the growing-stock inventory of South Dakota, the supply source of the State's primary wood-using industry. For a more complete discussion of fuelwood consumption by South Dakota households, see May (1996b).

Nonproduct Timber Removals

Some growing stock is removed from timberland and is not used for commercial products or fuelwood. Almost 4 million cubic feet of growing stock was nonproduct removals. Most of the nonproduct removals—nearly 3 million cubic feet—were removed from timberland due to a change in land-use classification. For example, on timberland where development such as housing construction occurs, the trees left standing are "removed" from the timberland classification because the development results in a land-use change. Also, land clearing, such as removing timber to improve grazing, results in nonproduct timber removals. Other nonproduct timber removals include logging residue from timber harvesting. Logging residue amounts to 1 million cubic feet of growing stock. Logging residue is the unused portion of cut trees or unused trees killed by logging.

OTHER LANDS WITH TREES MAKE IMPORTANT CONTRIBUTIONS

In South Dakota, some areas with trees are not timberland; instead they are nonforest land with trees. To be classified as nonforest land with trees, an area must contain at least one tree per acre that is at least 5 inches in d.b.h. but not qualify as forest land. There are nearly 1.3 million acres of nonforest land with trees in South Dakota. Nonforest land with trees include wooded pasture, narrow wooded strips and windbreaks, and urban and other lands with trees.

Seventy-three percent (917 thousand acres) of the nonforest land with trees is pasture. In recent years, eastern redcedar and Rocky Mountain juniper have expanded into pastures. The expansion of those species can have both negative and positive impacts in terms of livestock management. Their expansion can cause a loss of forage production, and livestock handling problems. Conversely, trees shade livestock, provide shelter against wind, and control soil erosion. Wooded pasture also provides habitat for various mammals and birds that are dependent on tree cover for survival. The rather extensive area of wooded pasture is indicative of the importance of woodland grazing to the farming and ranching economy of South Dakota, especially in western South Dakota where livestock grazing is common in ponderosa pine and quaking aspen stands. However, livestock grazing of woodlands can be problematic. Livestock grazing will eliminate understory plants, increase soil compaction and erosion, and reduce vegetation available for wildlife. Eventually, heavily grazed wooded areas will convert to grasslands.

There are an estimated 205 thousand acres of narrow wooded strips and windbreaks in South Dakota. Narrow wooded strips and windbreaks are not considered forest land because they are less than 120 feet wide. Narrow wooded strips and windbreaks include native woody vegetation found along rivers and streams, and plantings that consist of only a few rows of trees and shrubs found adjacent to homes and farm buildings (fig. 14). Narrow wooded strips totaled 95 thousand acres, and windbreaks totaled 110 thousand acres. Narrow wooded strips and windbreaks provide an array of benefits. These include wildlife habitat and travel corridors; wind protection for crops, livestock, and buildings; improved stream water quality; and outdoor recreation opportunities—they are excellent hunting grounds and places for wildlife observation. Narrow wooded strips and windbreaks are also valued for the visual diversity they provide. For some people the most important benefit is a source of residential fuelwood. Their importance as a source of fuelwood is amplified because of the relative scarcity of wood on the prairie. In 1994, for instance, about half of the residential fuelwood consumed in South Dakota came from nonforest land sources such as narrow wooded strips (May 1996b).

Many windbreak plantings have declined. Age, competition from herbaceous vegetation, and grazing have been strongly associated with windbreak decline in South Dakota (Schaefer *et al.* 1987). The area of narrow wooded riparian strips also has declined; in part, because of stream channelization, water impoundment projects, and livestock grazing. The aerial application of agriculture herbicides has weakened some trees in wooded strips and windbreaks, making them more susceptible to disease or insect attack. Dutch elm disease has taken a toll on American elm, once a dominant native species in riparian wooded strips.

Figure 14.—*Windbreaks, like this one in eastern Custer County, are a valuable tree resource. (Photo courtesy of South Dakota Department of Agriculture, Resource Conservation and Forestry Division.)*

In urban and other built-up areas of the State, there are more than 100 thousand acres of land with trees. These areas are an important component of the urban landscape and have a positive impact on the quality of life. Place names such as Box Elder, Cottonwood, Pine Ridge, Lone Tree, and Cedar Butte, are testaments of the important role trees have played in community development. However, the urban tree resource has declined in health and vigor. Dutch elm disease has reduced urban elm populations. Decay, brought on by old age, is a problem for urban cottonwood and box elder trees. Urban forest tree planting programs are working to restore the resource and increase species diversity.

FORESTS PROVIDE MANY BENEFITS

Residents and visitors to the State benefit from forests in many different ways. In this section, we discuss some of the benefits and values forests provide. Much of the evidence is anecdotal, and the discussion is intended to illustrate rather than define.

Forest Products Industry

South Dakota's forest products industry ranks as the fifth largest manufacturing industry in the State, representing 8 percent of the manufacturing workforce. According to the American Forest and Paper Association (1997), the lumber and wood products industry (Standard Industrial Classification Code 2400) and paper and allied products industry (Standard Industrial Classification 2600) employs 4,000 workers with a payroll income of $76 million. Most workers and payroll are in the lumber and wood products industry. For calendar year 1996, gross sales for the lumber and wood products industry totaled $171.1 million, whereas gross sales for the paper and allied products industry totaled $51.6 million (South Dakota Department of Revenue 1998). The value of shipments from establishments in the lumber and wood products industries, and the paper and allied products industries in South Dakota is $335.2 million (American Forest and Paper Association 1997). Value of shipments is a measure of the amount of money added to the economy.

Outdoor Recreation

Outdoor recreation is an important component of life in South Dakota. South Dakota's forest supplies recreation opportunities that produce significant benefits for the State's economy. Millions of visitors come to the Black Hills region annually for outdoor recreation purposes that include camping and trail use. The 110-mile George S. Mickelson Trail spans the entire length of the Black Hills from Deadwood to Edgemont, and is popular with hikers, horseback riders, cross-country skiers, and snowmobilers. The private sector, with its many recreational facilities, compete for recreationists' dollars with increasing zeal. Many of the towns in the region boomed during the gold-mining heyday of the 1880's and then declined, but many have been rejuvenated, in part, because of the region's abundant forest-based recreation opportunities. Further, South Dakota has 40 State parks and managed recreation areas, most provide excellent forest recreation opportunities or have groves of trees where people can have a picnic and enjoy the scenery.

Hunting is an important forest recreation activity that generates significant economic benefits. South Dakota offers some of the best wild turkey (*Meleagris gallopavo*), ring-necked pheasant (*Phasianus colchicus*), and deer (*Odocoileus virginianus* and *Odocoileus hemionus*) hunting available. Each year thousands of hunters enter the field. In 1997, for example, 416,000 hunting or fishing licenses were purchased of which more than a third (36 percent) were nonresident licenses (Cooper 1999). Nonresident license holders make significant contributions to the economy. In general, nonresidents pay three to four times more than residents do for the same or similar license. In 1997, total revenue from nonresident sales was about $7.4 million, compared to $5.4 million for resident sales (Cooper 1999). It should be noted that the South Dakota license fee structure is comparable to surrounding States. Also, woodland hunters contribute to communities and local businesses through hunting-related expenses. For example, a 3-day guided turkey hunting trip for two, including food and lodging, can cost more than $800.

An increasing number of people enjoy nonconsumptive wildlife recreation. About 228,000 South Dakotans over the age of 16—or 43 percent of the population—view, photograph, and feed wildlife. They spend about $40 million per year for equipment, food, and travel (Northern Prairie Wildlife Research Center 1999).

Agriculture

Forests provide a number of benefits to farmers and ranchers. For instance, livestock grazing in woodlands has a long tradition in South Dakota. Forests benefit grazing by producing forage in the form of grasses, forbs, and shrubs under trees, and in openings. Grazing can eliminate unwanted vegetative competition in developed stands. In western South Dakota, low intensity grazing of ponderosa pine forests is common. In the central part of the State, livestock graze mostly in gulches and stream bottoms. In eastern South Dakota, forest grazing is mostly in riparian areas or windbreaks.

Forests, including shelterbelts and windbreaks, protect fields, livestock, and buildings from the effects of wind. Protection from wind increases crop yield, and improves the quality of many wind-sensitive crops. Properly designed farmstead windbreaks reduce home energy cost by 15 to 20 percent (Heintz *et al.* 1986) and can increase the profitability of agricultural operations (Brandle *et al.* 1995).

Forests also provide raw material for agricultural uses. As noted previously, forests provide fuelwood for heating homes and outbuildings. Farmstead woodlots have long been a local source of wood for agriculture uses. As eastern redcedar expands, the species is finding use as posts, shavings, and logs on ranches and farms in South Dakota.

Visual/Spatial Diversity

Forest lands, windbreaks, and wooded strips occupy only about 5 percent of the total land area outside of the BHNF. However, they contribute significantly to visual diversity by giving the landscape a mosaic character. The early Euro-American settlers on the prairie planted trees to increase visual diversity (Sutton 1985). In rural areas, eastern redcedar was often planted around farmsteads, churches, and schools. The Black Hills forests present unparalleled scenery.

Spiritual Renewal and Sacraments

For centuries people have visited South Dakota's forests to seek spiritual renewal. Bear Butte, the pine-covered mountain known to the Lakota as Mato Paha, or Sleeping Bear Mountain, is such a place. Lakota and Cheyenne Indians still make pilgrimages to the mountain for ceremonies and prayer. Bear Butte is a dynamic and living cathedral. Native ceremonies include praying, fasting, and vision quests, which may last for several days (Vogel 1998). However, conflict between recreationists and spiritual pilgrims has become a problem (Vogel 1998).

Some forest wildlife and plant species are important in native spiritual ceremonies. For instance, some wildlife species are considered sacred. Some ceremonial artifacts are available only from forest plants or animals. Readers seeking more information on native people's customs and spirituality should refer to documents, such as Bane (1990), that provide a more in-depth discussion of the topic. Also, the South Dakota State History Society, Office of History, in the Department of Education and Cultural Affairs is an excellent source of information about South Dakota's native peoples and their use of forests.

Bird/Waterfowl Habitats

South Dakota is home to more than 200 breeding bird species (South Dakota Ornithologists' Union 1991). Many bird species that occur in the State require forest as habitat. Stand age and stand composition play an important role in bird population distribution and the species mix in an area. For instance, a young cottonwood or willow forest will have a different mix of birds than a middle-age or older stand. Young cottonwood stands, not as abundant as they once were, provide habitat for insectivorous birds, such as the yellow warbler (*Dendroica petechia*). Old stands with hollow trunks and branch scars provide habitat for cavity-nesting birds, such as the red-headed woodpecker (*Melanerpes erythrocephalus*). The old-growth ponderosa pine of the Black Hills is critical habitat for the three-toed woodpecker (*Picoides tridactylus*), a rare species. The three-toed woodpecker depends on snags and prefers burned forests (Finch 1992).

Forest species distribution influences the distribution of bird species. On the plains, coniferous forests are valuable bird habitat because other tree vegetation is scarce. For instance, the Rocky Mountain juniper forests in the Badlands provide habitat for bird species not found in adjacent grasslands (Seig and Uresk 1986). Eastern redcedar, a species that is expanding in South Dakota, is relished by many bird species, including the ring-necked pheasant, the bobwhite quail (*Colinus virginianus*), and the mourning dove (*Zenaida macroura*). The ring-necked pheasant, an introduced species, is normally associated with open farm or ranch lands, but eastern redcedar serves as important cover for wintering populations as protection from predators and hunters. Berries from both Rocky Mountain juniper and eastern redcedar trees are important food for birds. In western South Dakota, ponderosa pine provides excellent habitat for Merriam's turkey (*Meleagris gallopavo merriami*). Merriam's turkeys commonly nest under shrubs or slash in stands of ponderosa pine (Petersen and Richardson 1975). Large ponderosa pines are important turkey roost sites (Boeker and Scott 1969). In the wooded draws of south-central South Dakota, eastern cottonwood, American basswood (*Tilia americana*), and American elm are especially important for providing roost cover for wild turkey (Flake *et al.* 1995). The population of wood ducks (*Aix sponsa*) in South Dakota has expanded probably due to the distribution of mature trees. Mature hardwood trees, especially cottonwoods, around wooded lakes and wetlands support populations of wood ducks in all counties of South Dakota (Coughlin and Higgins 1994).

Small Mammal Habitats

Many small mammals thrive in South Dakota's forests. Tree squirrels (*Sciurus* spp.) have a strong preference for oak, depending on acorns for food. The eastern cottontail rabbit (*Sylvilagus floridanus*) primarily dwells in woodlands. The beaver (*Castor canadensis*) relies on forests that border lakes and flood plains in eastern South Dakota for both food and shelter. Various other smaller mammals including the raccoon depend on South Dakota's forests.

Tree species characteristics or traits can influence small mammal populations in an area. For instance, green ash, a species

common to lowland sites, produces large seed crops that provide food for a variety of small mammals. Dead and down trees provide hollows for nesting sites for small mammals, and fruit from eastern redcedar trees provides food.

Forest mammals, along with birds, play a significant role in tree species dispersal. By consuming and caching seeds, they become primary vectors of seed dispersion. For example, birds play a role in dispersing eastern redcedar seeds by depositing undigested seeds on open lands.

Large Mammal Habitats

The most common large mammal in South Dakota—the white-tailed deer—relies heavily on forests for food and shelter. In eastern South Dakota, windbreak and shelterbelt plantings provide excellent cover and forage opportunities for deer. Juniper woodlands are important mule deer habitat, providing food and cover, and winter browse. In the Black Hills, both white-tailed and mule deer rely on stands of ponderosa pine, white spruce, aspen, and bur oak for food and cover. Along with the deer, bison, elk (*Cervus canadensis*), and pronghorn antelope (*Antilocapra americana*) roam the expanses of grasslands and forests in western South Dakota. Bighorn sheep (*Ovis canadensis*) are found in the uplands of Custer State Park and in the area of Spring Creek and the Stratobowl. Mountain goats (*Oreamnos americanus*), an introduced species, are found in the higher mountains.

Forests are of direct importance to the survival of several endangered, threatened, or rare species that are present or thought to be present in South Dakota. Mountain lions (*Felis concolor*) traverse riparian forest or uplands with good cover; river otters (*Lutra canadensis*) use riparian wooded areas; and martens (*Martes americana*) need dense, mixed deciduous or mature coniferous forest. Reptiles whose continued presence is dependent on forest include the northern redbelly snake (*Storeria occipitomaculata occipitomaculata*) that relies on moist woodlands of eastern South Dakota. The eastern hognose snake's (*Heterodon platirhinos*) habitat includes open woods, and the lined snake's (*Tropidoclonion lineatum*) habitat includes sparsely wooded areas of southeast South Dakota. The Black Hills red-bellied snake (*Storeria occipitomaculata pahasapae*) inhabits the wooded hillsides, woodland edges, and moist open forest of the Black Hills (Finch 1992).

The State of South Dakota, through the Department of Game, Fish, and Parks offers a cost-share program for wildlife habitat improvement. The Department of Agriculture, Resource Conservation and Forestry Division offers assistance to landowners to help them achieve wildlife habitat improvement objectives. For instance, there is an ongoing landowner assistance program designed to ensure that landowners that plant shelterbelts do so with wildlife in mind.

Water Pollution Reduction

Forests and wooded strips play an important role in limiting the effects of agricultural contaminants on water quality. Modern agricultural practices contribute to water pollution in several different ways. For instance, the increasing number of irrigated acres requires increased fertilizer and herbicide use. Large livestock feedlots create sewage disposal problems. Runoff from feedlots threatens water quality. Trees and associated vegetation in riparian woodlands act as filter strips, removing contaminants before they wash into rivers, streams, and lakes. For example, in well-developed wooded riparian areas, typically those 90 to 150 feet wide, vegetation reduced nitrogen in ground water by 50 to 100 percent and in surface runoff by 78 to 98 percent (Lowrance 1992). The capacity of riparian wooded areas to immobilize and remove nutrients before they enter surface watercourses may also increase tree growth and improve fish and wildlife habitat.

THE OUTLOOK

South Dakota's forests are important in maintaining a vital social, economic, and diverse ecological environment. The State's forests have long endured and will continue to do so into the foreseeable future. However, how much forest there is, where it is located, and how it is used will remain a critically important public concerns. In this report, we provide information that can be useful to resource planners, administrators, managers,

and private landowners in meeting future resource management challenges. It has recently been mandated that the North Central Research Station's FIA program institute an annual forest inventory program that will inventory about 20 percent of the field plots in each State each year. After 5 years, all field plots will be completed, significantly reducing the cycle between inventories. For South Dakota, the most significant implication of the annual inventory is that field plots will be established on all ownerships and forest lands throughout the State. For the first time, the State's forest resources will be comprehensively inventoried. Not only will forest resource information and statistics be provided more expeditiously, but data will be collected to facilitate the maintenance of historical trend information.

Presently, the State and its residents face several significant forest resource questions. For example, will the cottonwood resource continue to decline and at what rate? We know that many cottonwood stands are old and that regeneration is a problem. For the near future, cottonwood volume may increase as more trees reach biological maturity. However, in the long term, if the species continues to decline, the ecological consequences could be profound because cottonwood and other riparian forests are key habitats for a variety of animal species and are especially important in maintaining biological diversity in a mostly prairie environment. Another important question centers on the mix of forest ownerships in the State and the management and use of forest lands. Much of the forest lands in South Dakota are publicly owned. What role will different ownership groups play in the arenas of forest management for timber, recreation opportunity, and biological diversity? Yet another important question concerns the advancing age of shelterbelts and windbreaks, especially in central and eastern South Dakota. The State of South Dakota, through the South Dakota Department of Agriculture, has active programs that promote tree planting and forest management. Sometimes cost-sharing programs are available for shelterbelt renovation. Between 1991 and 1996, an average of about 4,000 acres of private land per year were planted to trees (Moulton and Snellgrove 1997). However, what other initiatives or programs might lead to increased tree planting? For example, will the potential to gain income from hunters by developing wildlife habitat lead to more tree plantings?

Innovative solutions will be required to effectively deal with the challenges associated with South Dakota forest resources. The Forest Service's FIA program recognizes the need for more comprehensive and relevant data and analyses to meet those challenges. In the future, in partnership with public forest administrators and management agencies, and other interested groups, the FIA program will provide comprehensive and timely data and information that will facilitate effective management of forest resources in South Dakota.

APPENDIX

RELIABILITY OF THE SURVEY

Forest Inventory and Analysis information is based on a sampling procedure designed to provide reliable statistics at the State level. Consequently, the reported figures are estimates only. A measure of reliability of these figures is given by sampling errors (see tabulation below). These sampling errors mean that the chances are two out of three that if a 100-percent inventory had been made, using the same methods, the results would have been within the limits indicated.

For example, the estimated growing-stock volume in South Dakota in 1996, 432.3 million cubic feet, has a sampling error of ± 4.2 percent (± 18.2 million cubic feet). The growing-stock volume from a 100-percent inventory would be expected to fall between 414.1 million cubic feet and 450.5 million cubic feet (432.3 ± 18.2), there being a one in three chance that this is not the case.

Item	State totals	Sampling error
Growing stock	(Million cubic feet)	(Percent)
Volume (1996)	432.3	4.2
Average annual growth (1980-1995)	7.9	8.0
Average annual removals (1980-1995)	1.2	27.2
Sawtimber	(Million board feet)	
Volume (1996)	1,569.6	6.8
Average annual growth (1980-1995)	33.4	9.8
Average annual removals (1980-1995)	4.1	24.4
Area	(Thousand acres)	
Timberland area (1996)	575.0	3.8

As survey data are broken down into sections smaller than State totals, the sampling error increases. For example, the sampling error for timberland area in a particular county or county grouping is higher than that for total timberland area in the State. To estimate sampling error for data smaller than State totals, use the formula at the top of the next column.

$$E = \frac{(SE)\sqrt{(\text{State total volume or area})}}{\sqrt{(\text{Volume or area smaller than State total})}}$$

Where :

E = Sampling error in percent.

SE = State total error for volume or area.

For example, to compute the error on the area of timberland in the ponderosa pine type for the State, proceed as follows:

1. Total statewide area of ponderosa pine type from table 3 = 290.1 thousand acres.
2. Total area for all timberland in South Dakota from table 3 = 575.0 thousand acres.
3. South Dakota total error for timberland area from table 52 = 3.8 percent.
4. Using the above formula:

$$E = \frac{(3.8)\sqrt{575.0}}{\sqrt{290.1}}$$

E= 5.3 percent sampling error for the ponderosa pine forest type in South Dakota. Sampling errors for area, volume, growth, and removals for both growing stock and sawtimber are shown in table 52 for forest survey unit. Sampling errors for area and volume for growing stock and sawtimber by river basins are also shown in table 52.

SURVEY PROCEDURES

The survey procedures used in this inventory are described in detail in Hansen (In prep.). (Note: In previous inventories of South Dakota's forest resources, the State was divided and surveyed by the North Central Station's and Intermountain Station's FIA units at different times. The date of the previous inventory is given as 1980/1984.) A summary of these procedures is presented here. This summary consists of three parts:

1. A description of the statistical design used in the inventory that deals with the methods used for stratification, aerial photo, and ground plot selection and estimation.

2. A description of the ground plot measurements that focuses on the plot design and changes in the design between the 1980/1984 and 1996 inventories.

3. A description of the methods used to compute items presented in this report (area, number of trees, volume, growth, mortality, removals, and biomass) from field plot measurements.

STATISTICAL DESIGN

The basic design for this inventory consists of two independent samples that were combined to provide an overall estimate of the forest resources of South Dakota. The first sample is based on the remeasurement of the 1980/1984 FIA inventory, and the second sample is based on the Natural Resources Conservation Service's National Resources Inventory (NRCS-NRI). These samples produce two independent estimates of the total forest resource in South Dakota and were combined, using statistically appropriate methods, to provide the best overall estimates possible.

SAMPLE BASED ON THE REMEASUREMENT OF THE 1980/1984 FIA INVENTORY

The first sample was based on the remeasurement of aerial photos and ground plots taken during the 1980 North Central FIA (NC-FIA) inventory of eastern South Dakota and the 1984 Intermountain FIA (INT-FIA) inventory of western South Dakota. These inventories used double (two phase) sampling for stratification as presented in Cochran (1977) and Loetsch and Haller (1964). Aerial photo plots were observed in the first phase, and field plots were measured on the ground in the second phase. Because the two FIA units used different aerial photo sampling procedures, the 1980 NC-FIA photo sampling procedures were applied to new photography in the West Unit to make aerial photo data from both units compatible with the NC-FIA procedures.

1980 NC-FIA Inventory Aerial Photo Plots (Phase 1)

The first phase of the 1980 NC-FIA inventory was a systematic sample of aerial photo plots distributed over the East Unit. This same procedure was applied in the West Unit (except in the BHNF) to new aerial photography. Since this inventory in the West Unit used the same photo interpretation methods as the 1980 inventory (but applied to current photography), it is referred to as the 1980 inventory in further discussion here.

Sampling was done using a grid at the intensity of 121 photo plots per township (6 miles by 6 miles). This gave a phase 1 sampling rate of one photo plot per 190.4 acres. Each photo sample plot was classified as *forest, nonforest with trees, nonforest without trees, questionable* (samples where the photo interpreter was unable to make a definite call between forest and nonforest), *unproductive, census water, or noncensus water.* The distribution of photo plots by aerial photo classification in the 1980 NC-FIA forest inventory was:

Aerial photo classification	East Unit	West Unit
Forest	1,642	2,580
Questionable	451	79
Unproductive	59	0
Nonforest with trees	2,202	1,277
Nonforest without trees	193,076	45,494
Noncensus water	263	98
Census water	3,939	157
Total	201,632	49,685

1980 NC-FIA Inventory Ground Plots (Phase 2)

A systematic sample of the aerial photo plots was selected for ground plots in phase 2 of the 1980 inventory. A total of 6,994 ground plots were selected from the 251,317 photo plots. These ground plot locations were carefully examined stereoscopically, pin-pricked on the aerial photo, and assigned a ground plot identification number. Ground plots that definitely were not forest land (those classified as nonforest without trees, noncensus water, or census water) were given a nonforest ground land-use classification (more detailed than the photo classification done on all photo plots) by the photo interpreter and not sent to the field for measurement. These plots are referred to as office ground plots. Ground plot locations that could possibly be forest land (those classified as forest, questionable, unproductive, or nonforest with trees) were sent to the field for ground classification. The average ground plot sampling intensity was

one ground plot per 6,892 acres. The distribution of ground plots by aerial photo classification in the 1980 NC-FIA inventory was:

Aerial photo classification	East Unit	West Unit
Forest	209	220
Questionable	60	15
Unproductive	8	0
Nonforest with trees	232	165
Nonforest without trees	3,676	2,316
Noncensus water	5	5
Census water	75	8
Total	4,265	2,729

Estimates of the forest resources presented in 1980 inventory reports are based on double sampling for stratification based on these seven strata.

Remeasurement of the 1980 NC-FIA Inventory

The aerial photo classification completed in the 1980 inventory was used for stratification in the first sample of the 1996 South Dakota forest resources. These 251,317 photo plots were used as the phase 1 sample to estimate the area in each of the six strata. The second phase used plots that were visited by field crews to sample and observe ground conditions (land use, volume, growth, mortality, removals, etc.) within the six strata.

The 1980/1984 ground plots measured in the field form the second phase of this sample. In the forest, nonforest with trees, questionable, and unproductive strata, remeasurement observations of every systematic ground plot location established during the 1980 inventory were used to estimate average ground conditions within each stratum in 1996. In the nonforest without trees, census water, and noncensus water strata, a cluster sampling scheme (using townships as clusters) was used to make repeated ground observations of the photo plots established in the 1980 inventory.

This sampling scheme was selected to improve our ability to estimate the area of forest, with particular emphasis on estimating the actual area of land change to and from forest. Because all stratification was based on the same photo classification used in the previous inventory, estimates of change in forest area cannot be biased by differences in the quality of the aerial photography, the equipment and techniques used, and the individual photo interpreters and their skills. This design maintained the same level of intensity as the previous inventory in the strata where we found most of the forest land in the 1980 inventory (the forest and questionable strata) and in those strata where we anticipated most of the additional forest land would come from (the nonforest with trees and unproductive strata). The photo plots that were classified as nonforest without trees, census water, and noncensus water in the 1980 inventory were, by far, the largest portion of the 1980 photo sample. In addition, on a plot by plot basis, these strata were anticipated to have a low probability of currently being forest. Cluster sampling provided an efficient sample of this large area with a low probability of change, by examining a large number of locations at two points in time.

In the forest, questionable, unproductive, and nonforest with trees strata where double sampling was used, the ground plot sampling intensity was one plot per 1,774.1 acres. In the nonforest without trees, noncensus water, and census water strata where cluster sampling was used in the East Unit, 77 townships from the total 1,756 townships were sampled. The ground plot intensity in the East Unit for the nonforest without tree strata was 9,317 acres per plot.

Every ground plot in the 1996 inventory was classified for disturbance and other changes that may have taken place between 1980 and 1996. Disturbed plots are those that showed evidence of harvesting, insect or disease damage, land-use change, or other significant changes since the last inventory. A subset of the undisturbed forest ground plots were not remeasured. Instead, they were updated using the Stand and Tree Evaluation Modeling System (STEMS) (Belcher *et al.* 1982). The undisturbed forest plots that were remeasured were used to adjust the STEMS model for discrepancies between updated and actual remeasurements using methods presented in Hansen (1990) that have been used in previous NC-FIA inventories in Michigan, Minnesota, Iowa, Missouri, and Wisconsin. The undisturbed forest plots that were not remeasured are referred to as pseudo-remeasurement plots because they contain all

the data normally collected on a remeasurement plot (new plot and tree level data) but without the expense of a field visit. This methodology has been very efficient in other States inventoried by NC-FIA. Not remeasuring these undisturbed forest plots made available the resources needed to establish additional ground plots for the second inventory based on NRCS-NRI.

SAMPLE BASED ON NRCS-NRI

Just before this inventory, the Natural Resources Conservation Service (NRCS) conducted its National Resources Inventory (NRI) in the Plains States (U.S. Department of Agriculture 1991) using a two-stage sampling design. This sample design consisted of 160-acre and 640-acre primary sampling units (PSU) with three 2-acre secondary sampling units (SSU) located within the PSU's. The NRCS-NRI inventory sampled all lands except those owned by the Federal government. Estimates of the 1996 forest resources on Federal lands (primarily Army Corps of Engineers lands, and Bureau of Indian Affairs lands) come entirely from the remeasurement of the FIA inventory described in the previous section. The data collected in the NRI formed the basis for stratification of the second independent inventory.

This second portion of the overall inventory of South Dakota forest resources used the NRCS-NRI area estimates and point data as its basis for stratification and ground plot location in a double sampling scheme similar to the first inventory (the remeasurement of the 1980/1984 FIA field ground plots). The number of 2-acre SSU plots that were sampled by NRCS in the South Dakota NRI were:

	East	West
Forest (20 percent tree cover or greater	646	195
Nonforest (less than 20 percent tree cover)	17,418	1,831
Total	18,064	2,026

NC-FIA photo classified and installed standard NC-FIA ground plots at a subset of the NRI-SSU plot locations. This subsampling formed the basis of the estimation of means within strata. The average sampling intensity in the forest stratum was one ground plot per 6,364 acres in the East Unit, and one ground plot per 7,318 acres in the West Unit. In the nonforest stratum the sampling intensity was one ground plot per 66,424 acres in the East Unit, and one ground plot per 64,532 acres in the West Unit.

COMBINED ESTIMATE BASED ON THE TWO INDEPENDENT INVENTORIES

These two inventories produced two independent estimates of the forest resources in South Dakota. Final estimates presented in this report are based on weighted averages from these two independent estimates. Weighting was proportional to the number of ground plots on forest land for the estimates of most items including area, number of trees, volume, growth, mortality, and biomass. Weighting based on the number of remeasurement plots on forest land was used for estimates of items that can only be obtained from remeasurement plots, including removals and area change over time.

Field Measurements: 1980/1984 Inventory Plot Design

On plots classified as timberland, wooded pasture, or windbreak (at least 120 feet wide), a ground plot was established, remeasured, or the growth and mortality of its trees were predicted using the STEMS models. Old plots selected for remeasurement that could not be relocated were replaced with new plots at the approximate locations of the old plots.

In the East Unit, each ground plot consisted of a cluster of 10 subplots collectively covering approximately 1 acre. Trees 5.0 inches or greater in d.b.h. were sampled using 37.5 basal area factor (BAF) variable-radius plots, and trees less than 5.0 inches d.b.h. were sampled on 6.8-foot radius (1/300-acre) microplots established at the center of subplots 1, 2, and 3. Under the estimation procedures used in this inventory, an entire plot was represented by a single condition class where condition was determined by forest type, stand-size class, land use, stand origin, and density. Thus, the locations of the 10 subplots within the plot were adjusted if any subplot were located in a condition class different from that of subplot 1. In particular, if a subplot was located outside the condition class of the plot, it was re-established or rotated into the condition class used for the

entire plot. For example, if subplots 1 through 9 were located in forest land, and subplot 10 was located in a pasture, then subplot 10 was rotated back into the forest land condition class. In the West Unit, the plot design was similar, but only five subplots over a 1-acre area were measured using 40 BAF variable-radius plots for trees greater than 5.0 inches d.b.h. and a 1/300th acre microplot at all subplots.

Field Measurements: 1996 Inventory Plot Design

Field ground plots were established, remeasured, or the growth and mortality of their trees were predicted using the STEMS models for all forest lands (including reserved forest land, unproductive forest land, and timberland), wooded pasture, or windbreaks (at least 120 feet wide). Establishing ground plots on all forest lands represented a major change between the 1980/1984 and 1996 inventories.

In 1996, the overall plot layout consisted of 10 subplots arranged in a cluster with 70 feet between subplots. The basic locations of plots and subplots were the same as in the 1980 NC-FIA plot layout. All trees less than 5 inches in d.b.h. were measured on 6.8-foot radius (1/300th acre) microplots established at the centers of all 10 subplots. (In 1980, these microplots were measured only on subplots 1, 2, and 3). This radius was the maximum distance at which a 5.0-inch d.b.h. tree would be selected using a BAF of 37.5. Trees with diameters between 5 and 17 inches were selected for measurement at each of the 10 subplots with a BAF of 37.5. All trees greater than 17 inches d.b.h. located within a 24-foot radius macro-subplot centered at each of the 10 subplots were selected for measurement.

In 1996, subplots of the same plot were not rotated, even if they were located in multiple condition classes or straddled condition classes. As in 1980/1984, factors determining condition class were forest type, stand-size class, land use, stand origin, and density. Plots with multiple condition classes were mapped in the field to record how the boundaries between classes split the plot. This procedure identified the area of the plot located in each class and assigned each tree to a specific class. When multiple condition classes occurred on a plot, all information normally collected for the plot as a whole, such as forest type, site index, stand age, and stand-size class, was collected for each condition class.

On remeasured plots, the rotated subplots and all trees measured from the 1980/1984-plot design were also remeasured in 1996 to obtain change data such as growth and mortality. On new plots, subplots were not rotated.

New Inventory Plots

New ground plots were selected from the plots identified in NC-FIA's evaluation of the NRCS-NRI inventory. These new ground plots were established, and measures of current classification such as land use, forest type, and ownership, as well as size and condition of all trees on the plot, were recorded. These locations were monumented for future remeasurement.

Old Inventory Plots

Old inventory plots are those plots established, monumented, and measured as part of the 1980/1984 field inventory. The procedures for these old plots were different from those for new plots. Old plots were classified as "disturbed" on the basis of aerial photo analyses if either: (1) a reduction in vegetation on the plot occurred between inventories that resulted in a detectable change in the structure or function of the plant community; or (2) conditions on the plot were such that the STEMS models were unable to accurately predict growth or mortality. Plots not predicted to be disturbed were classified as "undisturbed". All disturbed plots and a one-third sample of the undisturbed plots were remeasured to obtain estimates of current conditions and changes since the last inventory. All remaining live trees measured on these plots in 1980/1984 were remeasured, and all new trees were identified and measured.

About two-thirds of the sample plots that were in timberland at the time of the 1980 inventory and predicted to be undisturbed until this inventory were not remeasured. Growth and mortality for these plots were predicted using the STEMS models as a means of obtaining growth and current volume. A comparison of

the predicted growth and mortality for these undisturbed plots and observations for growth and mortality for the one-third sample of remeasured undisturbed plots was used to adjust the model predictions to accommodate local conditions. The adjustment procedure is a modified version of the method described by Smith (1983).

The undisturbed timberland plots whose growth and mortality were predicted were treated in the estimation process as measured ground plots, even though they were not visited by field crews. The plot records for these plots were sent to the field for verification of current ownership information. All old plots classified as disturbed were selected for remeasurement to assess and verify changes since the last inventory. Because of differences between NC-FIA and INT-FIA procedures, the disturbance sampling described here was not applied in the West Unit, and all old INT-FIA plot locations were remeasured. Table A summarizes the distribution of all ground plots for the 1994 South Dakota inventory by type and plot.

COMPUTATION OF ESTIMATES: AREA

All area estimates were made using two-phase estimation methods. In this type of estimation, a preliminary estimate of area by land use is obtained from the stratification (Phase 1) and corrected by the plot measurements (Phase 2). A complete description of this estimation method is presented by Loetsch and Haller (1964).

COMPUTATION OF ESTIMATES: VOLUME

Estimates of volume per acre were made from the measurements and predictions for trees on each of the 10 subplots per plot. For each condition class on a plot, the volume per acre estimate was multiplied by the area estimate represented by the condition, and these products were summed over all plots to obtain estimates of total volume for the condition class. Net cubic and board foot volumes are based on tree measurements (d.b.h., tree class, and site index) and volume equations presented by Hahn and Hansen (1991).

COMPUTATION OF ESTIMATES: GROWTH AND MORTALITY

On remeasured plots, estimates of growth and mortality per acre were derived from remeasurements and observations of trees that died between inventories. These estimates were based on the remeasurement of the 1980 inventory plots using the 1980 plot design. Growth, reported as average annual net growth between the 1980 and 1996 inventories, was computed from data for both plots that had been remeasured and plots whose growth and mortality had been predicted using methods presented by VanDeusen *et al.* (1986). Average annual mortality was also calculated for the remeasurement period.

Table A.—*Distribution of ground plots by ground land-use class and type of plot, inventory of South Dakota's forest resources outside the Black Hills National Forest, 1996*

	Sample base[1]								
	1980/1984 FIA remeasurement				NRCS-NRI				
	Remeasured		Projected		New		Total plots		
	East	West	East	West	East	West	East	West	Total
Timberland	122	200	10	0	51	25	183	225	408
Reserved forest land	1	0	0	0	0	0	1	0	1
Other forest land	12	20	0	0	0	6	12	26	38
Nonforest with trees	350	187	1	0	82	12	433	199	632
Nonforest w/o trees	3,681	2,314	0	0	597	142	4,278	2,456	6,734
Water	88	13	0	0	3	1	91	14	105
Total	4,254	2,734	11	0	733	186	4,998	2,920	7,918

[1] *Plots that straddle more than one land use are included in the table in the first land-use class that occurs on this list. For example, a plot that straddled other forest land and water would be included in this table as other forest land.*

On new plots, estimates of growth and mortality were obtained by using the STEMS models to predict growth and mortality for 1 year. Current diameter and living tree estimates for old undisturbed plots were predicted using growth and mortality predictions and were derived in the same manner as for remeasured plots. Predictions of growth and mortality using the STEMS models were adjusted for each survey unit to accommodate local conditions using data from the undisturbed remeasured plots. As with volume, total growth and mortality estimates were obtained by multiplying the plot-level per acre estimates by area expansion factors and then summing over plots. Current annual net growth for 1995 was computed using adjusted, 1-year STEMS predictions of growth for all inventory plots.

COMPUTATION OF ESTIMATES: AVERAGE ANNUAL REMOVALS

Average annual growing-stock and sawtimber removals (1980-1995) were estimated only from the remeasured plots. These estimates were based on the remeasurement of the old inventory plots using the appropriate old plot design. Measurements for new plots and predictions from the STEMS models were not used to estimate removals. These estimates were obtained from trees measured in the last inventory and either cut or otherwise removed from the timberland base. Because remeasurement plots constitute about one-half the total ground plots, and not all remeasured plots had cutting, average annual removals estimates have greater sampling errors than volume and growth estimates.

TREE AND LOG GRADES

The USDA Forest Service reports all board foot volume in International 1/4-inch rule. Log grades and tree grades are based on the classification of external characteristics as indicators of quality. Log grades or tree grades were taken on approximately one-third of the sample plots in South Dakota. All softwood sawtimber sample trees were graded for quality and assigned a butt log grade. All hardwood sawtimber sample trees were graded for quality and assigned a tree grade. The volume yield by log grade or tree grade for this sample was used to distribute the volume of the ungraded sample trees by species group.

Hardwood sawtimber trees were graded according to "Hardwood Tree Grades for Factory Lumber" (Hanks 1976). The best 12-foot section of the lowest 16-foot hardwood log was used for grading. Hardwood sawtimber trees that did not meet minimum tree grade specifications for grades 1 through 3 were assigned grade 4 according to Forest Service standard specifications for hardwood construction logs described in "A Guide to Hardwood Log Grading" (Rast *et al.* 1973).

Eastern redcedar sawtimber trees were graded according to Forest Service standard specifications. For all softwoods, the first merchantable 16-foot log or shorter lengths down to 12 feet were used for grading.

Hardwood Tree Grades for Factory Lumber [a]

Grade factor	Tree grade 1	Tree grade 2	Tree grade 3
Length of grading zone (feet)	Butt 16	Butt 16	Butt 16
Length of grading section [b] (feet)	Best 12	Best 12	Best 12
D.b.h., minimum (inches)	16[c]	13	11
D.i.b., minimum at top of grading section (inches)	13[c] 16 20	11[d] 12	8
Clear cuttings (on the three best faces):[e]			
Length, minimum (feet)	7 5 3	3 3	2
Number on face (maximum)	2	2 3	unlimited
Yield in face length (minimum)	5/6	4/6	3/6
Cull deduction (including crook and sweep, but excluding shake) maximum within grading section (percent)	9	f	50

a Hanks (1976)

b Whenever a 14- or 16-foot section of the butt 16-foot log is better than the best 12-foot section, the grade of the longer section will become the grade of the tree. This longer section is the basis for determining the grading factors such as diameter and cull deduction.

c In basswood and ash, diameter inside bark (d.i.b.) at top of grading section must be 12 inches and d.b.h. must be 15 inches.

d Grade 2 trees can be 10 inches d.i.b. at top of grading section if otherwise meeting surface requirements for small grade 1's.

e A clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth of the surface of the grading section as divided lengthwise.

f Fifteen percent crook and sweep or 40 percent total cull deduction are permitted in grade 2, if size and surface of grading section qualify as grade 1. If rot shortens the required clear cuttings to the extent of dropping the butt log to grade 2, do not drop the tree's grade to 3 unless the cull deduction for rot is greater than 40 percent.

Forest Service Standard Specifications for Hardwood Construction
Logs (tie and timber logs) [a] [b]

Position in tree	Butts and uppers
Minimum diameter, small end	8 inches
Minimum length without trim	8 feet
Clear cuttings	No requirements
Sweep allowance	One-fourth of the diameter at small end for each 8 feet of length.
Sound surface defects:	
Single knots	Any number, if no knot has an average diameter above the callus in excess of one-third of the log diameter at point of occurrence.
Whorled knots	Any number, if the sum of knot diameters above the callus does not exceed one-third of the log diameter at point of occurrence.
Holes	Any number, provided none has a diameter over one-third of log diameter at point of occurrence and none extends more than 3 inches into included timber[c].
Unsound defects :	
Surface	Same requirements as for sound defects if they extend into included timber. No limit if they do not.
Interior	None permitted except one shake not more than one-third the width of contained tie or timber, and one split, not over 5 inches.

[a] Rast *et al.* (1973).

[b] These specifications are minimum for the class. If, from a group of logs, factory logs are selected first, thus leaving only nonfactory logs from which to select construction logs, then the quality range of the construction logs so selected is limited, and the class may be considered a grade. If selection for construction logs is given first priority, it may be necessary to subdivide the class into grades.

[c] Included timber is always square, and dimension is judged from small end.

Log Grades for Ponderosa Pine and Other Softwoods Logs

Grade 1

1. Trees must be 16 inches in diameter or larger, grading section 12 feet in length or longer, and with deduction for defect not over 30 percent of gross scale.

2. Trees must be at least 75 percent clear on each of three faces.

3. All knots outside clear cutting must be sound and not more than 2-1/2 inches in size.

Grade 2

1. Trees must be 12 inches in diameter or larger, grading section 12 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross scale deducted for defect.

2. Trees must be at least 50 percent clear on each of three faces or 75 percent clear on two faces.

Grade 3

1. Trees must be 6 inches in diameter or larger, grading section 12 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross contents of the log.

Note: Diameters are diameter inside bark (d.i.b.) at small end of grading section. Percent clear refers to percent clear in one continuous section.

METRIC EQUIVALENTS

1 acre = 4,046.86 square meters or 0.405 hectare.
1,000 acres = 405 hectares.
1 cubic foot = 0.0283 cubic meter.
1 foot = 30.48 centimeters or 0.3048 meter.
1 inch = 25.4 millimeters, 2.54 centimeters, or 0.0254 meter.
1 pound = 0.454 kilograms.
1 ton = 0.907 metric tons.

TREE SPECIES GROUPS IN SOUTH DAKOTA

(Little 1981)

Note: Many additional tree species have been planted around homes, farm buildings, and in towns and cities. However, only those species encountered during the 1996 inventory of the forest resources of South Dakota are listed here.

SOFTWOODS

Ponderosa pine ..... *Pinus ponderosa*
Eastern redcedar ..... *Juniperus virginiana*
Rocky Mountain juniper ..... *J. scopulorum*
White spruce ..... *Picea glauca*

HARDWOODS

Boxelder[1] ..... *Acer negundo*
Silver maple[1] ..... *A. saccharinum*
Sugar maple[2] ..... *A. saccharum*
Hackberry ..... *Celtis occidentalis*
Ashes[2]
  White ash ..... *Fraxinus americana*
  Green ash ..... *F. pennsylvanica*
Eastern cottonwood[1] ..... *Populus deltoides*
Black cherry[2] ..... *Prunus serotina*
Bur oak[2] ..... *Quercus macrocarpa*
White oak[2] ..... *Q. alba*
American basswood[1] ..... *Tilia americana*
Black willow[1] ..... *Salix nigra*
Elm
  American elm[1] ..... *Ulmus americana*
  Siberian elm[1] ..... *U. pumila*
  Slippery elm[1] ..... *U. rubra*
  Rock elm[2] ..... *U. thomasii*
Aspen[1]
  Quaking ..... *Populus tremuloides*
  Bigtooth ..... *P. grandidentata*
Paper birch[1] ..... *Betula papyrifera*
Other hardwoods
  White mulberry[1] ..... *Morus alba*
  Red mulberry[1] ..... *M. rubra*
  Honeylocust[2] ..... *Gleditsia triacanthos*

NONCOMMERCIAL SPECIES

Eastern hophornbeam ..... *Ostrya virginiana*
Peachleaf willow ..... *Salix amygdaloides*

[1]*This species or species group is considered a soft hardwood, with an average specific gravity of less than 0.50.*
[2]*This species or species group is considered a hard hardwood, with an average specific gravity greater than or equal to 0.50.*

DEFINITION OF TERMS

Average annual mortality of growing stock.—The average cubic foot volume of sound wood in growing-stock trees that died in one year. Average annual mortality is the average for the years between inventories (1980 to 1995 in this report).

Average annual mortality of sawtimber.—The average board foot volume of sound wood in sawtimber trees that died in one year. Average annual mortality is the average for the years between inventories (1980 to 1995 in this report).

Average annual net growth of growing stock.—The annual change in cubic foot volume of sound wood in live sawtimber and poletimber trees, and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes. Average net annual growing stock is the average for the years between inventories (1980 to 1995 in this report).

Average annual net growth of sawtimber.—The annual change in the board foot volume of live sawtimber trees, and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes. Average net annual growth of sawtimber is the average for the years between inventories (1980 to 1995 in this report).

Average annual removals from growing stock.—The average net growing-stock volume in growing-stock trees removed annually for roundwood forest products, in addition to the volume of logging residues and the volume of other removals. Average annual removals of growing stock are the average for the years between inventories (1980 to 1995 in this report) and are based on information obtained from remeasurement plots (see Survey Procedures in Appendix).

Average annual removals from sawtimber.—The average net board foot sawtimber volume of live sawtimber trees removed annually for roundwood forest products, in addition to the volume of logging residues and the volume of other removals. Average annual removals of sawtimber are the average for the years between inventories (1980 to 1995 in this report) and are based on information obtained from remeasurement plots (see Survey Procedures in Appendix).

Basal area.—Tree area in square feet of the cross section at breast height of a single tree. When the basal areas of all trees in a stand are summed, the result is usually expressed as square feet of basal area per acre.

Biomass.—The aboveground volume of all live trees (including bark but excluding foliage) reported in green tons (i.e., green weight). Biomass has four components:

Bole.—Biomass of a tree from 1 foot above the ground to a 4-inch top outside bark.

Tops and limbs.—Total biomass of a tree from a 1-foot stump minus the bole.

1- to 5-inch trees.—Total aboveground biomass of a tree from 1 to 5 inches in diameter at breast height.

Stump.—Biomass of a tree 5 inches d.b.h. and larger from the ground to a height of 1 foot.

Bolts.—Roundwood logs of less than 8 feet in length that are converted into shingles, cooperage stock, dimension stock, blocks, blanks, excelsior, etc. No minimum diameter limits. Does not include logs used for the manufacture of pulp or veneer.

Commercial species.—Tree species presently or prospectively suitable for industrial wood products. (Note: Excludes species of typically small size, poor form, or inferior quality.)

Cord.—One standard cord is 128 cubic feet of stacked wood, including bark and air space. Cubic feet can be converted to solid wood standard cords by dividing by 79.

Corporate.—Lands owned by a private corporation not in the business of operating primary wood-using plants.

County and municipal land.—Land owned by counties and local public agencies or municipalities, or land leased to these governmental units for 50 years or more.

Cropland.—Land under cultivation within the last 24 months; including cropland harvested, crop failures, cultivated summer fallow, idle cropland used only for pasture, orchards, active Christmas tree plantations indicated by annual shearing, nurseries, and land in soil improvement crops, but excluding land cultivated in developing improved pasture.

Cull.—Portions of a tree that are unusable for industrial wood products because of rot, missing or dead material, form, or other defect.

Current annual net growth of growing stock.—The annual change in volume of sound wood in live sawtimber and poletimber trees, and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes, reported for a single year (1995 in this report). Current growth is based on an estimate of the current annual increment of each growing-stock tree in the inventory.

Current annual net growth of sawtimber.—The annual change in the volume of live sawtimber trees, and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes, reported for a single year (1995 in this report). Current growth is based on an estimate of the current annual increment of each sawtimber tree in the inventory.

Current annual removals from growing stock.—The current net growing-stock volume in growing-stock trees removed annually for roundwood forest products, in addition to the volume of logging residues, and the volume of other removals. Current annual removals of growing stock are reported for a single year (1993 in this report); they are based on a survey of primary wood processing mills to determine removals for products and on information from remeasurement plots (see Survey Procedures in Appendix) to determine removals due to land-use change.

Current annual removals from sawtimber.—The current net board foot sawtimber volume of live sawtimber trees removed annually for roundwood forest products, in addition to the volume of logging residues, and the volume of other removals. Current annual removals of sawtimber are reported for a single year (1993 in this report); they are based on a survey of primary wood processing mills to determine removals for products and on information from remeasurement plots (see Survey Procedures in Appendix) to determine removals due to land-use change.

Diameter class.—A classification of trees based on diameter outside bark, measured at breast height 4.5 feet above the ground. (Note d.b.h. is the common abbreviation for diameter at breast height.) Two-inch diameter classes are commonly used in Forest Inventory and Analysis, with the even inch the approximate midpoint for a class. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h.

Diameter at breast height (d.b.h.).—The outside bark diameter at 4.5 feet (1.37 m) above the forest floor on the uphill side of the tree. For determining breast height, the forest floor includes the duff layer that may be present, but does not include unincorporated woody debris that may rise above the ground line.

Federal land.—Land administered by agencies of the Federal government.

Forest land.—Land at least 10 percent stocked (Note: Historically 16.7 percent was used based on full stocking equaling 167 percent. Consequently, this was equal to a standard of 10 percent based on a 100-percent scale that is now used.) by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use. (Note: Stocking is measured by comparing specified standards with basal area and/or number of trees, age or size, and spacing.) The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Unimproved roads and trails, streams, or other bodies of water or clearings in forest areas shall be classed as forest if less than 120 feet wide. (See Tree, Land, Timberland, Reserved forest land, Other forest land, Stocking, and Water.)

Forest type.—A classification of forest land based on the species forming a plurality of live tree stocking. The associated species for each forest type are based on net volume of growing stock and all live biomass by species group from the 1996 inventory of South Dakota forests. Forest types in South Dakota are:

Ponderosa pine.—Forests in which ponderosa pine comprises a plurality of the stocking. Species commonly associated with the ponderosa pine forest type in South Dakota are bur oak, white spruce, quaking aspen, paper birch, and to a lesser degree, elm, ash, and cottonwood.

Eastern redcedar.—Forests in which eastern redcedar comprises a plurality of the stocking. A commonly associated species in South Dakota is cottonwood and to a lesser degree bur oak and elm.

Rocky Mountain juniper.—Forests in which Rocky Mountain juniper comprises a plurality of the stocking. A commonly associated species in South Dakota is ponderosa pine, and to a lesser degree, ash, bur oak, and elm.

Eastern redcedar-hardwoods.—Forests in which hardwoods comprise a plurality of the stocking but in which eastern redcedar makes up between 25 and 50 percent of the stocking. Species commonly associated with the eastern redcedar-hardwoods forest type in South Dakota include bur oak, elm, and ash.

Bur oak.—Forests in which bur oak comprises a plurality of the stocking. Species commonly associated with the bur oak forest type in South Dakota are ponderosa pine, ash, cottonwood, elm, and to a lesser degree, basswood, hackberry, quaking aspen, and eastern redcedar.

Cottonwood.—Forests in which cottonwood comprises a plurality of the stocking. Species commonly associated with the cottonwood forest type in South Dakota are ash, elm, bigtooth aspen, and to a lesser degree, soft maple.

Willow.—Forests in which black willow comprises a plurality of the stocking. Species commonly associated with the willow forest type in South Dakota include cottonwood, elm, and to a lesser degree, ash.

Elm-ash-soft maple.—Forests in which ash, elm, and soft maple comprise a plurality of the stocking. Species commonly associated with the elm-ash-soft maple forest type in South Dakota include cottonwood, willow, hackberry, and to a lesser degree, bur oak.

Maple-basswood.—Forests in which basswood and soft maple comprise a plurality of the stocking. Species commonly associated with the maple-basswood forest type in South Dakota include ash, bur oak, and elm.

Elm-ash-locust.—Forests in which elm, white and green ash, and honey locust comprise a plurality of the stocking. Species commonly associated with the elm-ash-locust forest type in South Dakota include cottonwood, bur oak, ponderosa pine, hackberry, basswood, soft maple, and to a lesser degree, eastern redcedar and willow.

Aspen-birch.—Forests in which aspen and paper birch comprise a plurality of the stocking. Species commonly associated with the aspen-birch forest type in South Dakota include ponderosa pine, white spruce, and to a lesser degree, bur oak.

Growing-stock tree.—A live tree of commercial species that meets specified standards of size, quality, and merchantability. (Note: Excludes rough, rotten, and dead trees.)

Growing-stock volume.—Net volume in cubic feet of growing-stock trees 5.0 inches d.b.h. and over, from 1 foot above the ground to a minimum 4.0-inch top diameter outside bark of the central stem or to the point where the central stem breaks into limbs.

Hard hardwoods.—Hardwood species with an average specific gravity greater than 0.50 such as oaks, hard maple, hickories, and ash.

Hardwoods.—Dicotyledonous trees, usually broad-leaved and deciduous. (See Soft hardwoods and Hard hardwoods.)

Indian land.—Land held in trust by the United States for tribes or individual Indians.

Industrial wood.—All roundwood products except residential fuelwood.

Land.—*(a) Bureau of the Census.* Dry land and land temporarily or partly covered by water such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tide); streams, sloughs, estuaries, and canals less than one-eighth of a statute mile wide; and lakes, reservoirs, and ponds less than 40 acres in area.

(b) Forest Inventory and Analysis. The same as the Bureau of the Census, except minimum width of streams, etc., is 120 feet and minimum size of lakes, etc., is 1 acre.

Live trees.—Growing-stock, rough, and rotten trees 1.0 inch d.b.h. and larger.

Log grade.—A log classification based on external characteristics as indicators of quality or value. Log grade was assigned to a sample of softwood sawtimber trees throughout the State during the 1996 inventory. Also see Tree grade. (See Appendix for specific grading factors used.)

Logging residue.—The unused portions of cut trees, plus unused trees killed by logging.

Marsh.—Nonforest land that characteristically supports low, generally herbaceous or shrubby vegetation, and that is intermittently covered with water.

Merchantable.—Refers to a pulpwood or saw-log section that meets pulpwood or saw-log specifications, respectively.

Net volume.—Gross volume less deductions for rot, sweep, or other defect affecting use for timber products.

Noncommercial species.—Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products.

Nonforest land.—Land that has never supported forests, and land formerly forested where use for timber management is precluded by development for other uses. (Note: Includes areas used for crops, active Christmas tree plantations as indicated by annual shearing, orchards, nurseries, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width, and 1- to 40-acre areas of water

classified by the Bureau of the Census as land.) If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide and more than 1 acre in area to qualify as nonforest land.

a. Nonforest land without trees.—Nonforest land with no live trees present.

b. Nonforest land with trees.—Nonforest land with one or more trees per acre at least 5 inches d.b.h.

Nonstocked land.—Timberland less than 10 percent stocked with all live trees.

Other forest land.—Forest land not capable of producing 20 cubic feet per acre per year of industrial wood crops under natural conditions and not associated with urban or rural development. Many of these sites contain tree species that are not currently used for industrial wood production or trees of poor form, small size, or inferior quality that are unfit for most industrial products. Unproductivity may be the result of adverse site conditions such as sterile soil, dry climate, poor drainage, high elevation, and rockiness. This land is not withdrawn from timber use.

Other removals.—Growing-stock trees removed but not used for products, or trees left standing but "removed" from the timberland classification by land-use change. Examples are removals from cultural operations such as timber stand improvement work and land clearing, and the standing volume on land classified originally as timberland but later designated as reserved from timber harvesting (such as a newly established State park).

Ownership size class.—The amount of timberland owned by one owner, regardless of the number of parcels.

Pasture with trees.—Land presently used for grazing and less than 10 percent stocked with trees.

Physiographic class.—A measure of soil and water conditions that affect tree growth on a site. The physiographic classes are:

Xeric sites.— Very dry soils where excessive drainage seriously limits both growth and species occurrence. These sites are usually on upland and upper half slopes.

Xeromesic sites.—Moderately dry soils where excessive drainage limits growth and species occurrence to some extent. These sites are usually on the lower half slopes.

Mesic sites.—Deep, well-drained soils. Growth and species occurrence are limited only by climate. These include all cove sites and bottomlands along intermittent streams.

Hydromesic sites.—Moderately wet soils where insufficient drainage or infrequent flooding limits growth and species occurrence to some extent.

Hydric sites.—Very wet sites where excess water seriously limits both growth and species occurrence.

Plant byproducts.—Plant residues used for products such as mulch, pulp chips, and fuelwood.

Plantation.—An artificially reforested area sufficiently productive to qualify as timberland. The planted species is not necessarily predominant. Christmas tree plantations, which are considered cropland, are not included.

Plant residues.—Wood and bark materials generated at manufacturing plants during production of other products.

Poletimber stand.—(See Stand-size class.)

Poletimber tree.—A live tree of commercial species at least 5.0 inches d.b.h., but smaller than sawtimber size.

Potential productivity class.—A classification of forest land in terms of inherent capacity to grow crops of industrial wood. The class identifies the potential growth in merchantable cubic feet/acre/year at culmination of mean annual increment of fully stocked natural stands.

Private individual land.—Privately owned land not owned by forest industry. This class includes the formerly used Farmer and Miscellaneous private classes.

Reserved forest land.—Forest land withdrawn from timber use through statute, administrative regulation, or designation. Note: Christmas tree plantations were once classified as reserved forest land. Now, however, they are classified as cropland.

Rotten tree.—Live trees of commercial species that do not contain at least one 12-foot saw log or two saw logs 8 feet or longer, now or prospectively, and/or do not meet regional specifications for freedom from defect primarily because of rot; that is, when more than 50 percent of the cull volume in a tree is rotten.

Rough tree.—(a) Live trees of commercial species that do not contain at least one merchantable 12-foot saw log or two saw logs 8 feet or longer, now or prospectively, and/or do not meet regional specifications for freedom from defect primarily because of roughness or poor form, and (b) all live trees of noncommercial species.

Roundwood products.—Logs, bolts, or other round sections (including chips from roundwood) cut from trees for industrial or consumer uses. (Note: Includes saw logs, veneer logs, and bolts; cooperage logs and bolts; pulpwood; fuelwood; pilings; poles; posts; hewn ties; mine timbers; and various other round, split, or hewn products.)

Salvable dead tree.—A standing or down dead tree considered merchantable by regional standards.

Sapling.—A live tree 1.0 to 5.0 inches d.b.h.

Sapling-seedling stand.—(See Stand-size class.)

Saw log.—A log meeting minimum standards of diameter, length, and defect, including logs at least 8 feet long, sound and straight, and with a minimum diameter outside bark (d.o.b.) for softwoods of 7.0 inches (9.0 inches for hardwoods) or other combinations of size and defect specified by regional standards.

Saw-log portion.—That part of the bole of sawtimber trees between the stump and the saw-log top.

Saw-log top.—The point on the bole of sawtimber trees above which a saw log cannot be produced. The minimum saw-log top is 7.0 inches d.o.b. for softwoods and 9.0 inches d.o.b. for hardwoods.

Sawtimber stand.—(See Stand-size class.)

Sawtimber tree.—A live tree of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer, and meeting regional specifications for freedom from defect. Softwoods must be at least 9.0 inches d.b.h. Hardwoods must be at least 11.0 inches d.b.h.

Sawtimber volume.—Net volume of the saw-log portion of live sawtimber in board feet, International 1/4-inch rule (unless specified otherwise), from stump to a minimum 7.0 inches top d.o.b. for softwoods and a minimum 9.0 inches top d.o.b. for hardwoods.

Seedling.—A live tree less than 1.0 inch d.b.h. that is expected to survive. Only softwood seedlings more than 6 inches tall and hardwood seedlings more than 1 foot tall are counted.

Short-log (rough tree).—A sawtimber-size tree of commercial species that contains at least one merchantable 8- to 11-foot saw log but not a 12-foot saw log.

Shrub.—A woody, perennial plant differing from a perennial herb in its persistent and woody stem(s) and less definitely from a tree in its lower stature and/or the general absence of a well-defined main stem. For this report, shrubs were separated somewhat arbitrarily into tall and low shrubs as follows:

Tall shrubs.—Normally taller than 1.6 to 3.2 feet.

Low shrubs.—Normally shorter than 1.6 to 3.2 feet. (Woody perennial vines, such as grape, were included with low shrubs.)

Shrub and tree seedling biomass.—The total aboveground weight of trees less than 1.0 inch in diameter and all shrubs.

Site index.—An expression of forest site quality based on the height of a free-growing dominant or codominant tree of a representative species in the forest type at age 50.

Soft hardwoods.—Hardwood species with an average specific gravity less than 0.50, such as cottonwood, silver maple, basswood, and willow.

Softwoods.—Coniferous trees, usually evergreen, having needles or scale-like leaves.

Stand.—A group of trees on a minimum of 1 acre of forest land that is stocked by forest trees of any size.

Stand-age class.—A classification based on age of the main stand. Main stand refers to trees of the dominant forest type and stand-size class.

Stand-size class.—A classification of stocked (see Stocking) forest land based on the size class of live trees on the area; that is, sawtimber, poletimber, or seedlings and saplings.

Sawtimber stands.—Stands with half or more of live tree stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

Poletimber stands.—Stands with half or more of live tree stocking in poletimber and/or sawtimber trees, and with poletimber stocking exceeding that of sawtimber.

Sapling-seedling stands.—Stands with more than half of the live tree stocking in saplings and/or seedlings.

State land.—Land owned by the State of South Dakota or leased to it for 50 years or more.

Stocking.—The degree of occupancy of land by live trees, measured by basal area and/or the number of trees in a stand by size or age and spacing, compared to the basal area and/or number of trees required to fully use the growth potential of the land; that is, the stocking standard. A stocking percent of 100 indicates full use of the site and is equivalent to 80 square feet of basal area per acre in trees 5.0 inches d.b.h. and larger. In a stand of trees less than 5 inches d.b.h., a stocking percent of 100 would indicate that the present number of trees is sufficient to produce 80 square feet of basal area per acre when the trees reach 5 inches d.b.h.

Stands are grouped into the following stocking classes:

Overstocked stands.—Stands in which stocking of live trees is 100 percent or more.

Fully stocked stands.—Stands in which stocking of live trees is from 60.0 to 99.9 percent.

Medium stocked stands.—Stands in which stocking of live trees is from 35.0 to 59.9 percent.

Poorly stocked stands.—Stands in which stocking of live trees is from 10.0 to 34.9 percent.

Nonstocked areas.—Timberland on which stocking of live trees is less than 10.0 percent.

Timber products output.—All timber products cut from roundwood and byproducts of wood manufacturing plants. Roundwood products include logs, bolts, or other round sections cut from growing-stock trees, cull trees, salvable dead trees, trees on nonforest land, noncommercial species, sapling-size trees, and limbwood. Byproducts from primary manufacturing plants include slabs, edging, trimmings, miscuts, sawdust, shavings, veneer cores and clippings, and screenings of pulpmills that are used as pulpwood chips or other products.

Timberland.—Forest land that is producing, or is capable of producing, more than 20 cubic feet per acre per year of industrial wood crops under natural conditions, that is not withdrawn from timber use, and that is not associated with urban or rural development. Currently inaccessible and inoperable areas are included. (Timberland was formerly called commercial forest land.)

Tree.—A woody plant usually having one or more erect perennial stems, a stem diameter at breast height of at least 3 inches, a more or less definitely formed crown of foliage, and a height of at least 13 feet at maturity.

Tree biomass.—The total aboveground weight (including the bark but excluding the foliage) of all trees from 1 to 5 inches in d.b.h., and the total aboveground weight (including the bark but excluding the foliage) from a 1-foot stump for trees more than 5 inches in diameter.

Tree grade.—A classification of the lower 16 feet of the bole of standing trees based on external characteristics as indicators of the quality and quantity of lumber that could be produced from the tree. Tree grade was assigned to a sample of hardwood sawtimber trees during the 1996 inventory. Also see Log grade. (See Appendix for specific grading factors used.)

Tree size class.—A classification of trees based on diameter at breast height, including sawtimber trees, poletimber trees, saplings, and seedlings.

Upper stem portion.—That part of the bole of sawtimber trees above the saw-log top to a minimum top diameter of 4.0 inches d.o.b. or to the point where the central stem breaks into limbs.

Urban and other areas.—Areas within the legal boundaries of cities and towns; suburban areas developed for residential, industrial, or recreational purposes; school yards; cemeteries; roads; railroads; airports; beaches; powerlines and other rights-of-way; or other nonforest land not included in any other specified land-use class.

Urban forest land.—Land that would otherwise meet the criteria for timberland but that is in an urban-suburban area surrounded by commercial, industrial, or residential development and not likely to be managed for the production of industrial wood products on a continuing basis. Wood removed would be for land clearing, fuelwood, or esthetic purposes. Such forest land may be associated with industrial, commercial, residential subdivision, industrial parks, golf course perimeters, airport buffer strips, and public urban parks that qualify as forest land.

Water.—*(a) Bureau of the Census.*—Permanent inland water surfaces, such as lakes, reservoirs, and ponds at least 40 acres in area; and streams, sloughs, estuaries, and canals at least one-eighth of a statute mile wide.

(b) Noncensus.—Permanent inland water surfaces, such as lakes, reservoirs, and ponds from 1 to 39.9 acres in area; and streams, sloughs, estuaries, and canals from 120 feet to one-eighth of a statute mile wide.

Windbreak.—A group of trees less than 120 feet wide used for protection of soil, cropfields, and buildings.

Wooded pasture.—Pasture with more than 10 percent stocking in live trees, but less than 25 percent stocking in growing-stock trees. Area is currently used for grazing or there is other evidence of grazing.

Wooded strip.—An acre or more of natural continuous forest land that would otherwise meet survey standards for timberland except that it is less than 120 feet wide.

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Table 42.—Current annual net growth of sawtimber on timberland by species group and local forest type, South Dakota outside the Black Hills National Forest, 1995

Table 43.—Current annual net growth and current annual mortality for 1995, and current annual removals for 1993, of growing stock and sawtimber on timberland by species group, South Dakota

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Supplemental Table for South Dakota

Table 53.—Area of timberland by forest type group/local forest type and stand-size class, South Dakota including the Black Hills National Forest, 1996

Table 1. -- Area of land by Forest Survey Unit, River Basin, and major land-use class, South Dakota outside the Black Hills National Forest, 1996

(In thousand acres)

Forest Survey Unit	Total land area [1]	Total forest land	Forest land			Other land [2]
			Timberland	Reserved forest land	Other forest land	
East	37,465.7	243.1	213.2	1.1	28.8	37,222.6
West	9,900.0	421.1	361.8	11.1	37.1	9,478.9
Total	47,365.7	664.2	575.0	12.2	65.9	46,701.5
River Basin						
Belle Fourche-Grand-Moreau [3]						
Lawrence	236.2	85.1	81.9	--	3.2	151.1
All other counties	7,901.3	50.0	48.1	--	1.9	7,851.3
Basin total	8,137.5	135.1	130.0	--	5.1	8,002.4
Cheyenne [4]						
Custer	654.6	92.9	80.3	10.0	2.6	561.7
Fall River	1,067.0	40.6	40.6	--	--	1,026.4
Pennington	1,370.3	72.5	50.0	1.1	21.4	1,297.8
All other counties	4,402.4	61.1	38.9	--	22.2	4,341.3
Basin total	7,494.3	267.1	209.8	11.1	46.2	7,227.2
White-Niobrara [5]						
Shannon	1,353.6	46.7	41.7	--	5.0	1,306.9
All other counties	8,551.2	71.2	56.0	--	15.2	8,480.0
Basin total	9,904.8	117.9	97.7	--	20.2	9,786.9
Bad-Missouri-Coteau-James [6]	16,606.2	81.8	79.0	--	2.8	16,524.4
Basin total	16,606.2	81.8	79.0	--	2.8	16,524.4
Minnesota-Big Sioux-Coteau [7]	5,222.9	62.3	58.5	1.1	2.7	5,160.6
Basin total	5,222.9	62.3	58.5	1.1	2.7	5,160.6

[1] From U.S. Bureau of the Census, 1990.

[2] Includes 155.5 thousand acres of water according to FIA standards of area classification, but defined by the Bureau of the Census as land.

[3] Belle Fourche-Grand-Moreau includes Butte, Corson, Dewey, Harding, Lawrence, and Perkins Counties.

[4] Cheyenne includes Custer, Fall River, Haakon, Meade, Pennington, and Ziebach Counties.

[5] White-Niobrara includes Bennett, Jackson, Mellette, Shannon, Todd, and Tripp Counties.

[6] Bad-Missouri-Coteau-James includes Aurora, Beadle, Bon Homme, Brown, Brule, Buffalo, Campbell, Charles Mix, Davison, Douglas, Edmunds, Faulk, Gregory, Hand, Hanson, Hughes, Hutchinson, Hyde, Jerauld, Jones, Lyman, McPherson, Miner, Potter, Sanborn, Spink, Stanley, Sully, Walworth, and Yankton Counties.

[7] Minnesota-Big Sioux-Coteau includes Brookings, Clark, Clay, Codington, Day, Deuel, Grant, Hamlin, Kingsbury, Lake, Lincoln, Marshall, McCook, Minnehaha, Moody, Roberts, Turner, and Union Counties.

Table 2. -- Area of timberland by Forest Survey Unit, River Basin, and ownership class, South Dakota outside the Black Hills National Forest, 1996

(In thousand acres)

		Ownership class						
Forest Survey Unit	All ownerships	National forest	Other federal	State	County and municipal	Indian	Corporate	Individual
East	213.2	--	3.6	3.5	1.2	53.9	7.6	143.4
West	361.8	24.7	4.2	50.5	--	38.6	47.7	196.1
Total	575.0	24.7	7.8	54.0	1.2	92.5	55.3	339.5
River Basin								
Belle Fourche-Grand-Moreau [1]	130.0	16.3	--	7.0	--	9.6	19.9	77.2
Cheyenne [2]	209.8	8.4	4.2	42.6	--	1.7	26.9	126.0
White-Niobrara [3]	97.7	--	--	0.9	--	72.6	2.0	22.2
Bad-Missouri-Coteau-James [4]	79.0	--	3.6	1.0	1.2	0.9	4.2	68.1
Minnesota-Big Sioux-Coteau [5]	58.5	--	--	2.5	--	7.7	2.3	46.0

[1] Belle Fourche-Grand-Moreau includes Butte, Corson, Dewey, Harding, Lawrence, and Perkins Counties.

[2] Cheyenne includes Custer, Fall River, Haakon, Meade, Pennington, and Ziebach Counties.

[3] White-Niobrara includes Bennett, Jackson, Mellette, Shannon, Todd, and Tripp Counties.

[4] Bad-Missouri-Coteau-James includes Aurora, Beadle, Bon Homme, Brown, Brule, Buffalo, Campbell, Charles Mix, Davison, Douglas, Edmunds, Faulk, Gregory, Hand, Hanson, Hughes, Hutchinson, Hyde, Jerauld, Jones, Lyman, McPherson, Miner, Potter, Sanborn, Spink, Stanley, Sully, Walworth, and Yankton Counties.

[5] Minnesota-Big Sioux-Coteau includes Brookings, Clark, Clay, Codington, Day, Deuel, Grant, Hamlin, Kingsbury, Lake, Lincoln, Marshall, McCook, Minnehaha, Moody, Roberts, Turner, and Union Counties.

Table 3. -- Area of timberland by Forest Survey Unit, River Basin, and forest type group/local type, South Dakota outside the Black Hills National Forest, 1996

(In thousand acres)

		Forest type group/local type														
		Ponderosa pine	Eastern redcedar			Rocky Mountain juniper	Oak-hickory	Elm-ash-cottonwood				Maple-beech-birch	Elm-ash-locust	Aspen-birch	Non-stocked
Forest Survey Unit	All types	Ponderosa pine	Total	Eastern redcedar	Eastern redcedar-hardwood	Rocky Mountain juniper	Bur oak	Total	Cottonwood	Elm-ash-soft maple	Willow	Maple-basswood	Elm-ash-locust	Aspen-birch	Non-stocked
East	213.2	14.6	14.3	8.3	6.0	4.7	50.3	50.3	27.5	17.4	5.4	5.1	73.8	--	0.1
West	361.8	275.5	--	--	--	8.8	25.9	9.3	8.1	1.2	--	--	8.4	23.0	10.9
Total	575.0	290.1	14.3	8.3	6.0	13.5	76.2	59.6	35.6	18.6	5.4	5.1	82.2	23.0	11.0
River Basin															
Belle Fourche-Grand-Moreau [1]	130.0	82.9	--	--	--	--	17.7	8.3	5.9	2.4	--	--	3.7	16.3	1.1
Cheyenne [2]	209.8	159.5	--	--	--	12.1	10.3	9.5	8.3	1.2	--	--	2.6	6.7	9.1
White-Niobrara [3]	97.7	47.7	3.5	3.5	--	1.4	21.8	13.8	8.0	4.1	1.7	--	8.8	--	0.7
Bad-Missouri-Coteau-James [4]	79.0	--	9.5	4.8	4.7	--	14.7	14.5	6.7	4.1	3.7	0.5	39.7	--	0.1
Minnesota-Big Sioux-Coteau [5]	58.5	--	1.3	--	1.3	--	11.7	13.5	6.7	6.8	--	4.6	27.4	--	--

[1] Belle Fourche-Grand-Moreau includes Butte, Corson, Dewey, Harding, Lawrence, and Perkins Counties.

[2] Cheyenne includes Custer, Fall River, Haakon, Meade, Pennington, and Ziebach Counties.

[3] White-Niobrara includes Bennett, Jackson, Mellette, Shannon, Todd, and Tripp Counties.

[4] Bad-Missouri-Coteau-James includes Aurora, Beadle, Bon Homme, Brown, Brule, Buffalo, Campbell, Charles Mix, Davison, Douglas, Edmunds, Faulk, Gregory, Hand, Hanson, Hughes, Hutchinson, Hyde, Jerauld, Jones, Lyman, McPherson, Miner, Potter, Sanborn, Spink, Stanley, Sully, Walworth, and Yankton Counties.

[5] Minnesota-Big Sioux-Coteau includes Brookings, Clark, Clay, Codington, Day, Deuel, Grant, Hamlin, Kingsbury, Lake, Lincoln, Marshall, McCook, Minnehaha, Moody, Roberts, Turner, and Union Counties.

Table 4. -- Area of timberland by Forest Survey Unit, River Basin, and stand-size class, South Dakota outside the Black Hills National Forest, 1996

(In thousand acres)

		Stand-size class			
Forest Survey Unit	All stands	Sawtimber	Poletimber	Sapling & seedling	Nonstocked
East	213.2	90.3	59.5	63.3	0.1
West	361.8	148.6	68.0	134.3	10.9
Total	575.0	238.9	127.5	197.6	11.0
River Basin					
Belle Fourche-Grand-Moreau [1]	130.0	62.3	11.2	55.4	1.1
Cheyenne [2]	209.8	75.5	56.3	68.9	9.1
White-Niobrara [3]	97.7	39.0	18.8	39.2	0.7
Bad-Missouri-Coteau-James [4]	79.0	21.1	27.8	30.0	0.1
Minnesota-Big Sioux-Coteau [5]	58.5	41.0	13.4	4.1	--

[1] Belle Fourche-Grand-Moreau includes Butte, Corson, Dewey, Harding, Lawrence, and Perkins Counties.

[2] Cheyenne includes Custer, Fall River, Haakon, Meade, Pennington, and Ziebach Counties.

[3] White-Niobrara includes Bennett, Jackson, Mellette, Shannon, Todd, and Tripp Counties.

[4] Bad-Missouri-Coteau-James includes Aurora, Beadle, Bon Homme, Brown, Brule, Buffalo, Campbell, Charles Mix, Davison, Douglas, Edmunds, Faulk, Gregory, Hand, Hanson, Hughes, Hutchinson, Hyde, Jerauld, Jones, Lyman, McPherson, Miner, Potter, Sanborn, Spink, Stanley, Sully, Walworth, and Yankton Counties.

[5] Minnesota-Big Sioux-Coteau includes Brookings, Clark, Clay, Codington, Day, Deuel, Grant, Hamlin, Kingsbury, Lake, Lincoln, Marshall, McCook, Minnehaha, Moody, Roberts, Turner, and Union Counties.

Table 5. -- Area of timberland by Forest Survey Unit, River Basin, and potential productivity class, South Dakota outside the Black Hills National Forest, 1996

(In thousand acres)

Forest Survey Unit	All classes	Potential productivity class (cubic feet of growth per acre per year) 120+	85-119	50-84	20-49
East	213.2	0.9	5.9	61.4	145.0
West	361.8	--	3.7	54.5	303.6
Total	575.0	0.9	9.6	115.9	448.6
River Basin					
Belle Fourche-Grand-Moreau [1]	130.0	--	3.7	29.7	96.6
Cheyenne [2]	209.8	--	--	23.5	186.3
White-Niobrara [3]	97.7	--	0.2	13.5	84.0
Bad-Missouri-Coteau-James [4]	79.0	0.9	3.3	23.3	51.5
Minnesota-Big Sioux-Coteau [5]	58.5	--	2.4	25.9	30.2

[1] Belle Fourche-Grand-Moreau includes Butte, Corson, Dewey, Harding, Lawrence, and Perkins Counties.

[2] Cheyenne includes Custer, Fall River, Haakon, Meade, Pennington, and Ziebach Counties.

[3] White-Niobrara includes Bennett, Jackson, Mellette, Shannon, Todd, and Tripp Counties.

[4] Bad-Missouri-Coteau-James includes Aurora, Beadle, Bon Homme, Brown, Brule, Buffalo, Campbell, Charles Mix, Davison, Douglas, Edmunds, Faulk, Gregory, Hand, Hanson, Hughes, Hutchinson, Hyde, Jerauld, Jones, Lyman, McPherson, Miner, Potter, Sanborn, Spink, Stanley, Sully, Walworth, and Yankton Counties.

[5] Minnesota-Big Sioux-Coteau includes Brookings, Clark, Clay, Codington, Day, Deuel, Grant, Hamlin, Kingsbury, Lake, Lincoln, Marshall, McCook, Minnehaha, Moody, Roberts, Turner, and Union Counties.

Table 6. -- Area of timberland by Forest Survey Unit, River Basin, and stocking class of growing-stock trees [1], South Dakota outside the Black Hills National Forest, 1996

(In thousand acres)

Forest Survey Unit	All classes	Stocking class of growing-stock trees				
		Non-stocked [2]	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked
East	213.2	11.9	132.6	38.7	27.2	2.8
West	361.8	24.2	162.6	104.0	70.2	0.8
Total	575.0	36.1	295.2	142.7	97.4	3.6
River Basin						
Belle Fourche-Grand-Moreau [3]	130.0	4.8	55.7	41.5	28.0	--
Cheyenne [4]	209.8	15.9	93.8	55.2	44.1	0.8
White-Niobrara [5]	97.7	8.5	60.8	23.4	5.0	--
Bad-Missouri-Coteau-James [6]	79.0	5.9	44.2	14.5	12.7	1.7
Minnesota-Big Sioux-Coteau [7]	58.5	1.0	40.7	8.1	7.6	1.1

[1] This table is based on the stocking percent of growing-stock trees, rather than that of "live" trees. For this table, to use the definition of stocking found in the Appendix, replace the term "live trees" with "growing-stock trees."

[2] Area of nonstocked in this table and in table 8 differs from that in other tables in this report because this table includes land stocked only with growing-stock trees, rather than with "live" trees.

[3] Belle Fourche-Grand-Moreau includes Butte, Corson, Dewey, Harding, Lawrence, and Perkins Counties.

[4] Cheyenne includes Custer, Fall River, Haakon, Meade, Pennington, and Ziebach Counties.

[5] White-Niobrara includes Bennett, Jackson, Mellette, Shannon, Todd, and Tripp Counties.

[6] Bad-Missouri-Coteau-James includes Aurora, Beadle, Bon Homme, Brown, Brule, Buffalo, Campbell, Charles Mix, Davison, Douglas, Edmunds, Faulk, Gregory, Hand, Hanson, Hughes, Hutchinson, Hyde, Jerauld, Jones, Lyman, McPherson, Miner, Potter, Sanborn, Spink, Stanley, Sully, Walworth, and Yankton Counties.

[7] Minnesota-Big Sioux-Coteau includes Brookings, Clark, Clay, Codington, Day, Deuel, Grant, Hamlin, Kingsbury, Lake, Lincoln, Marshall, McCook, Minnehaha, Moody, Roberts, Turner, and Union Counties.

Table7. -- Area of timberland by forest type group/local type and ownership class, South Dakota outside the Black Hills National Forest, 1996

(In thousand acres)

Forest type group by local type	All ownerships	Ownership class								
		Public					Private			
		Total public	National forest	Other federal	State	County and municipal	Total private	Indian	Corporate	Individual
Ponderosa pine										
Ponderosa pine	290.1	67.4	24.7	4.0	38.7	--	222.7	41.3	32.1	149.3
Total	290.1	67.4	24.7	4.0	38.7	--	222.7	41.3	32.1	149.3
Eastern redcedar										
Eastern redcedar	8.3	1.0	--	--	1.0	--	7.3	--	--	7.3
Eastern redcedar-hardwood	6.0	--	--	--	--	--	6.0	--	--	6.0
Total	14.3	1.0	--	--	1.0	--	13.3	--	--	13.3
Rocky Mountain juniper										
Rocky Mountain juniper	13.5	2.6	--	0.2	2.4	--	10.9	1.4	1.6	7.9
Total	13.5	2.6	--	0.2	2.4	--	10.9	1.4	1.6	7.9
Oak-hickory										
Bur oak	76.2	5.1	--	--	5.1	--	71.1	21.2	4.5	45.4
Total	76.2	5.1	--	--	5.1	--	71.1	21.2	4.5	45.4
Elm-ash-cottonwood										
Cottonwood	35.6	3.6	--	2.4	--	1.2	32.0	6.7	4.7	20.6
Elm-ash-soft maple	18.6	1.1	--	1.1	--	--	17.5	2.4	--	15.1
Willow	5.4	--	--	--	--	--	5.4	2.1	--	3.3
Total	59.6	4.7	--	3.5	--	1.2	54.9	11.2	4.7	39.0
Maple-beech-birch										
Maple-basswood	5.1	1.2	--	--	1.2	--	3.9	3.9	--	--
Total	5.1	1.2	--	--	1.2	--	3.9	3.9	--	--
Elm-ash-locust										
Elm-ash-locust	82.2	1.3	--	--	1.3	--	80.9	12.8	3.7	64.4
Total	82.2	1.3	--	--	1.3	--	80.9	12.8	3.7	64.4
Aspen-birch										
Aspen-birch	23.0	--	--	--	--	--	23.0	--	7.6	15.4
Total	23.0	--	--	--	--	--	23.0	--	7.6	15.4
Nonstocked	11.0	4.4	--	0.1	4.3	--	6.6	0.7	1.1	4.8
All types	575.0	87.7	24.7	7.8	54.0	1.2	487.3	92.5	55.3	339.5

Table 8. -- Area of timberland by ownership class and stocking class of growing-stock trees [1], South Dakota outside the Black Hills National Forest, 1996

(In thousand acres)

Ownership class	All classes	Stocking class of growing-stock trees				
		Non-stocked [2]	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked
Public						
National forest	24.7	--	16.3	2.9	4.7	0.8
Other federal	7.8	1.2	0.3	2.4	3.9	--
State	54.0	5.9	23.1	4.5	20.5	--
County and municipal	1.2	--	--	--	1.2	--
Total	87.7	7.1	39.7	9.8	30.3	0.8
Private						
Indian	92.5	8.8	60.3	18.9	4.5	--
Corporate	55.3	1.1	22.4	22.1	9.7	--
Individual	339.5	19.1	172.8	91.9	52.9	2.8
Total	487.3	29.0	255.5	132.9	67.1	2.8
All ownerships	575.0	36.1	295.2	142.7	97.4	3.6

[1] This table is based on the stocking percent of growing-stock trees, rather than that of "live" trees. For this table, to use the definition of stocking found in the Appendix, replace the term "live trees" with "growing-stock trees."

[2] Area of nonstocked in this table and in table 6 differs from that in other tables in this report because this table includes land stocked only with growing-stock trees, rather than with "live" trees.

Table 9. -- Area of timberland by forest type group/local type and stand-size class, South Dakota outside the Black Hills National Forest, 1996

(In thousand acres)

Forest type group by local type	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling & seedling	Nonstocked
Ponderosa pine					
Ponderosa pine	290.1	145.5	67.8	76.8	--
Total	290.1	145.5	67.8	76.8	--
Eastern redcedar					
Eastern redcedar	8.3	1.2	--	7.1	--
Eastern redcedar-hardwood	6.0	--	2.8	3.2	--
Total	14.3	1.2	2.8	10.3	--
Rocky Mountain juniper					
Rocky Mountain juniper	13.5	--	2.8	10.7	--
Total	13.5	--	2.8	10.7	--
Oak-hickory					
Bur oak	76.2	16.0	19.2	41.0	--
Total	76.2	16.0	19.2	41.0	--
Elm-ash-cottonwood					
Cottonwood	35.6	32.0	2.5	1.1	--
Elm-ash-soft maple	18.6	8.4	4.4	5.8	--
Willow	5.4	2.1	3.3	--	--
Total	59.6	42.5	10.2	6.9	--
Maple-beech-birch					
Maple-basswood	5.1	3.4	1.7	--	--
Total	5.1	3.4	1.7	--	--
Elm-ash-locust					
Elm-ash-locust	82.2	29.9	23.0	29.3	--
Total	82.2	29.9	23.0	29.3	--
Aspen-birch					
Aspen-birch	23.0	0.4	--	22.6	--
Total	23.0	0.4	--	22.6	--
Nonstocked	11.0	--	--	--	11.0
All types	575.0	238.9	127.5	197.6	11.0

Table 10. -- Number of all live trees on timberland by species group and diameter class, South Dakota outside the Black Hills National Forest, 1996

(In thousand trees)

Species group	All classes	Diameter class (inches at breast height)											
		1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+
Softwoods													
Ponderosa pine	113,718	44,649	25,074	16,521	11,304	7,434	4,067	2,319	1,168	694	316	172	--
White spruce	651	124	62	231	101	70	26	33	--	--	4	--	--
Eastern redcedar	9,930	8,104	1,364	104	252	68	38	--	--	--	--	--	--
Other softwoods	14,258	7,812	4,759	1,164	387	81	36	12	6	--	--	1	--
Total	138,557	60,689	31,259	18,020	12,044	7,653	4,167	2,364	1,174	694	320	173	--
Hardwoods													
Select white oak	16,845	4,242	4,313	3,576	2,151	1,159	631	284	203	140	72	60	14
Basswood	1,074	363	86	131	88	151	135	55	24	33	4	4	--
Soft maple	276	177	--	--	--	--	--	17	7	3	28	42	2
Elm	13,487	6,330	3,510	1,563	1,026	420	356	144	71	31	22	14	--
White & green ash	16,057	7,141	3,655	1,834	1,357	1,044	605	226	102	34	23	36	--
Cottonwood	3,431	977	181	273	465	166	200	228	289	171	63	311	107
Willow	233	51	--	39	16	33	24	54	13	2	--	1	--
Hackberry	1,808	768	455	191	135	160	66	28	--	5	--	--	--
Bigtooth aspen	12	--	--	--	--	--	--	12	--	--	--	--	--
Quaking aspen	4,724	3,033	493	611	444	93	35	15	--	--	--	--	--
Paper birch	5,346	3,143	1,520	553	104	26	--	--	--	--	--	--	--
Black cherry	32	--	--	31	--	--	--	--	--	--	--	1	--
Other hardwoods	5,400	1,971	1,086	1,057	406	371	280	106	33	52	15	19	4
Total	68,725	28,196	15,299	9,859	6,192	3,623	2,332	1,169	742	471	227	488	127
Noncommercial species	14,213	12,324	1,129	545	24	78	47	25	20	18	2	1	--
All species	221,495	101,209	47,687	28,424	18,260	11,354	6,546	3,558	1,936	1,183	549	662	127

Table 11. -- Number of growing-stock trees on timberland by species group and diameter class, South Dakota outside the Black Hills National Forest, 1996

(In thousand trees)

Species group	All classes	Diameter class (inches at breast height)											
		1.0-2.9	3.0-4.9	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+
Softwoods													
Ponderosa pine	107,115	44,144	23,100	14,851	10,038	6,736	3,757	2,167	1,161	694	298	169	--
White spruce	453	124	62	50	101	53	26	33	--	--	4	--	--
Eastern redcedar	9,493	8,104	1,094	73	164	31	27	--	--	--	--	--	--
Other softwoods	11,213	7,673	2,552	814	117	39	13	5	--	--	--	--	--
Total	128,274	60,045	26,808	15,788	10,420	6,859	3,823	2,205	1,161	694	302	169	--
Hardwoods													
Select white oak	10,226	4,068	2,799	1,345	965	587	285	73	43	38	10	9	4
Basswood	830	363	86	83	38	102	89	37	4	20	4	4	--
Soft maple	258	177	--	--	--	--	--	17	5	3	18	38	--
Elm	10,293	6,054	2,443	914	540	152	96	49	15	16	7	7	--
White & green ash	12,799	6,874	3,026	1,004	733	569	309	154	58	27	21	24	--
Cottonwood	3,144	977	181	273	439	152	183	176	210	155	36	268	94
Willow	148	51	--	39	--	8	16	25	6	2	--	1	--
Hackberry	1,572	768	420	191	37	138	18	--	--	--	--	--	--
Quaking aspen	3,874	2,969	329	228	295	28	25	--	--	--	--	--	--
Paper birch	5,003	3,143	1,238	517	89	16	--	--	--	--	--	--	--
Black cherry	1	--	--	--	--	--	--	--	--	--	--	1	--
Other hardwoods	2,323	1,171	581	251	117	94	104	--	--	5	--	--	--
Total	50,471	26,615	11,103	4,845	3,253	1,846	1,125	531	341	266	96	352	98
All species	178,745	86,660	37,911	20,633	13,673	8,705	4,948	2,736	1,502	960	398	521	98

Table 12. -- Net volume of growing stock on timberland by species group and diameter class, South Dakota outside the Black Hills National Forest, 1996

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height)									
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29+
Softwoods											
Ponderosa pine	272,915	25,562	38,462	46,681	43,835	38,717	29,725	23,791	13,703	12,439	--
White spruce	2,041	76	375	449	340	605	--	--	196	--	--
Eastern redcedar	1,347	130	661	248	308	--	--	--	--	--	--
Other softwoods	1,983	1,112	370	249	162	90	--	--	--	--	--
Total	278,286	26,880	39,868	47,627	44,645	39,412	29,725	23,791	13,899	12,439	--
Hardwoods											
Select white oak	22,469	2,989	4,523	4,941	3,914	1,555	1,285	1,391	547	605	719
Basswood	4,869	211	169	949	1,346	795	152	782	206	259	--
Soft maple	5,255	--	--	--	--	353	202	105	1,039	3,556	--
Elm	9,665	1,877	2,383	1,227	1,312	951	478	593	331	513	--
White & green ash	24,097	2,065	3,521	5,189	4,495	3,299	1,817	1,092	1,096	1,523	--
Cottonwood	77,068	603	2,392	1,515	2,866	4,116	7,250	7,059	2,210	25,251	23,806
Willow	1,367	60	--	80	186	601	193	115	--	132	--
Hackberry	1,846	444	154	1,016	232	--	--	--	--	--	--
Quaking aspen	2,518	542	1,394	227	355	--	--	--	--	--	--
Paper birch	1,271	812	342	117	--	--	--	--	--	--	--
Black cherry	91	--	--	--	--	--	--	--	--	91	--
Other hardwoods	3,512	591	517	756	1,443	--	--	205	--	--	--
Total	154,028	10,194	15,395	16,017	16,149	11,670	11,377	11,342	5,429	31,930	24,525
All species	432,314	37,074	55,263	63,644	60,794	51,082	41,102	35,133	19,328	44,369	24,525

Table 13. -- Net volume of growing stock in the saw-log portion of sawtimber trees on timberland by species group and diameter class, South Dakota outside the Black Hills National Forest, 1996

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Ponderosa pine	181,849	34,486	37,075	34,793	27,624	22,560	13,170	12,141	--
White spruce	1,376	351	292	545	--	--	188	--	--
Eastern redcedar	470	201	269	--	--	--	--	--	--
Other softwoods	396	179	137	80	--	--	--	--	--
Total	184,091	35,217	37,773	35,418	27,624	22,560	13,358	12,141	--
Hardwoods									
Select white oak	8,203	--	2,800	1,265	1,114	1,246	505	570	703
Basswood	2,969	--	1,021	662	137	710	193	246	--
Soft maple	4,914	--	--	283	180	95	963	3,393	--
Elm	3,395	--	909	751	416	529	303	487	--
White & green ash	10,876	--	3,207	2,666	1,579	982	1,012	1,430	--
Cottonwood	68,382	--	2,179	3,469	6,462	6,479	2,072	24,256	23,465
Willow	963	--	103	469	162	103	--	126	--
Hackberry	158	--	158	--	--	--	--	--	--
Quaking aspen	251	--	251	--	--	--	--	--	--
Black cherry	85	--	--	--	--	--	--	85	--
Other hardwoods	1,149	--	965	--	--	184	--	--	--
Total	101,345	--	11,593	9,565	10,050	10,328	5,048	30,593	24,168
All species	285,436	35,217	49,366	44,983	37,674	32,888	18,406	42,734	24,168

Table 14. -- Net volume of sawtimber on timberland by species group and diameter class, South Dakota outside the Black Hills National Forest, 1996

(In thousand board feet) [1]

Species group	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Ponderosa pine	1,017,312	215,482	208,603	189,121	148,364	120,569	70,548	64,625	--
White spruce	6,808	1,918	1,465	2,582	--	--	843	--	--
Eastern redcedar	2,930	1,333	1,597	--	--	--	--	--	--
Other softwoods	2,371	1,163	774	434	--	--	--	--	--
Total	1,029,421	219,896	212,439	192,137	148,364	120,569	71,391	64,625	--
Hardwoods									
Select white oak	48,722	--	18,568	7,474	6,255	6,802	2,711	3,040	3,872
Basswood	18,658	--	6,934	4,164	814	4,197	1,121	1,428	--
Soft maple	24,787	--	--	1,508	903	471	4,799	17,106	--
Elm	18,842	--	5,692	4,217	2,214	2,732	1,541	2,446	--
White & green ash	59,306	--	18,719	14,377	8,253	5,114	5,295	7,548	--
Cottonwood	354,597	--	12,391	18,834	34,461	34,163	11,025	129,569	114,154
Willow	5,145	--	694	2,470	834	523	--	624	--
Hackberry	1,049	--	1,049	--	--	--	--	--	--
Quaking aspen	1,640	--	1,640	--	--	--	--	--	--
Black cherry	485	--	--	--	--	--	--	485	--
Other hardwoods	6,940	--	6,018	--	--	922	--	--	--
Total	540,171	--	71,705	53,044	53,734	54,924	26,492	162,246	118,026
All species	1,569,592	219,896	284,144	245,181	202,098	175,493	97,883	226,871	118,026

[1] International 1/4-inch rule.

Table 15. -- Net volume of sawtimber on timberland by Forest Survey Unit, species group, and grade, South Dakota outside the Black Hills National Forest, 1996

(In thousand board feet) [1]

All Units

Species group	Total	Log grade			
		Log grade 1	Log grade 2	Log grade 3	Log grade 4
Softwoods					
Ponderosa pine	1,017,312	22,572	85,334	909,406	--
White spruce	6,808	--	--	6,808	--
Eastern redcedar	2,930	--	--	2,930	--
Other softwoods	2,371	--	--	2,371	--
Total	1,029,421	22,572	85,334	921,515	--

Species group	Total	Tree grade			
		Tree grade 1	Tree grade 2	Tree grade 3	Tie and timber
Hardwoods					
Select white oak	48,722	--	5,609	13,596	29,517
Basswood	18,658	1,008	9,247	8,403	--
Soft maple	24,787	14,574	5,694	1,846	2,673
Elm	18,842	--	1,077	11,469	6,296
White & green ash	59,306	3,834	8,723	34,639	12,110
Cottonwood	354,597	162,319	60,646	99,823	31,809
Willow	5,145	--	--	3,091	2,054
Hackberry	1,049	--	--	1,049	--
Quaking aspen	1,640	--	--	1,640	--
Black cherry	485	--	--	485	--
Other hardwoods	6,940	--	--	937	6,003
Total	540,171	181,735	90,996	176,978	90,462
All species	1,569,592	204,307	176,330	1,098,493	90,462

East

Species group	Total	Log grade			
		Log grade 1	Log grade 2	Log grade 3	Log grade 4
Softwoods					
Ponderosa pine	80,388	1,111	8,282	70,995	--
White spruce	--	--	--	--	--
Eastern redcedar	2,930	--	--	2,930	--
Other softwoods	2,175	--	--	2,175	--
Total	85,493	1,111	8,282	76,100	--

Species group	Total	Tree grade			
		Tree grade 1	Tree grade 2	Tree grade 3	Tie and timber
Hardwoods					
Select white oak	42,016	--	5,727	12,602	23,687
Basswood	18,658	1,008	9,247	8,403	--
Soft maple	24,787	14,574	5,694	1,846	2,673
Elm	18,186	--	1,040	11,069	6,077
White & green ash	58,514	3,848	8,754	33,760	12,152
Cottonwood	306,525	142,784	45,420	100,634	17,687
Willow	5,145	--	--	3,091	2,054
Hackberry	1,049	--	--	1,049	--
Quaking aspen	--	--	--	--	--
Black cherry	485	--	--	485	--
Other hardwoods	6,940	--	--	937	6,003
Total	482,305	162,214	75,882	173,876	70,333
All species	567,798	163,325	84,164	249,976	70,333

West

Species group	Total	Log grade			
		Log grade 1	Log grade 2	Log grade 3	Log grade 4
Softwoods					
Ponderosa pine	936,924	21,411	77,167	838,346	--
White spruce	6,808	--	--	6,808	--
Eastern redcedar	--	--	--	--	--
Other softwoods	196	--	--	196	--
Total	943,928	21,411	77,167	845,350	--

Species group	Total	Tree grade			
		Tree grade 1	Tree grade 2	Tree grade 3	Tie and timber
Hardwoods					
Select white oak	6,706	--	--	1,110	5,596
Basswood	--	--	--	--	--
Soft maple	--	--	--	--	--
Elm	656	--	38	399	219
White & green ash	792	--	--	792	--
Cottonwood	48,072	20,178	13,402	2,925	11,567
Willow	--	--	--	--	--
Hackberry	--	--	--	--	--
Quaking aspen	1,640	--	--	1,640	--
Black cherry	--	--	--	--	--
Other hardwoods	--	--	--	--	--
Total	57,866	20,178	13,440	6,866	17,382
All species	1,001,794	41,589	90,607	852,216	17,382

[1] International 1/4-inch rule.

Table 16. -- Net volume of growing stock and sawtimber on timberland by Forest Survey Unit, River Basin, and major species group, South Dakota outside the Black Hills National Forest, 1996

Forest Survey Unit	Growing stock					Sawtimber				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	(In thousand cubic feet)					*(In thousand board feet)* [1]				
East	155,176	18,543	2,380	92,043	42,210	567,798	80,388	5,105	381,161	101,144
West	277,138	254,372	2,991	14,859	4,916	1,001,794	936,924	7,004	50,368	7,498
Total	432,314	272,915	5,371	106,902	47,126	1,569,592	1,017,312	12,109	431,529	108,642
River Basin										
Belle Fourche-Grand-Moreau [2]	124,027	92,260	2,041	23,742	5,984	495,465	378,865	6,808	96,945	12,847
Cheyenne [3]	151,291	138,254	1,192	10,524	1,321	507,001	465,324	302	41,375	--
White-Niobrara [4]	64,014	39,512	23	18,979	5,500	253,489	159,426	--	82,756	11,307
Bad-Missouri-Coteau-James [5]	37,357	--	1,530	24,528	11,299	114,149	--	3,822	86,924	23,403
Minnesota-Big Sioux-Coteau [6]	55,625	2,889	585	29,129	23,022	199,488	13,697	1,177	123,529	61,085

[1] International 1/4-inch rule.

[2] Belle Fourche-Grand-Moreau includes Butte, Corson, Dewey, Harding, Lawrence, and Perkins Counties.

[3] Cheyenne includes Custer, Fall River, Haakon, Meade, Pennington, and Ziebach Counties.

[4] White-Niobrara includes Bennett, Jackson, Mellette, Shannon, Todd, and Tripp Counties.

[5] Bad-Missouri-Coteau-James includes Aurora, Beadle, Bon Homme, Brown, Brule, Buffalo, Campbell, Charles Mix, Davison, Douglas, Edmunds, Faulk, Gregory, Hand, Hanson, Hughes, Hutchinson, Hyde, Jerauld, Jones, Lyman, McPherson, Miner, Potter, Sanborn, Spink, Stanley, Sully, Walworth, and Yankyon Counties.

[6] Minnesota-Big Sioux-Coteau includes Brookings, Clark, Clay, Codington, Day, Deuel, Grant, Hamlin, Kingsbury, Lake, Lincoln, Marshall, McCook, Minnehaha, Moody, Roberts, Turner, and Union Counties.

Table 17. -- Net volume of all live trees and salvable dead trees on timberland by class of timber and major species group, South Dakota outside the Black Hills National Forest, 1996

(In thousand cubic feet)

Class of timber	All species	Major species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
Live trees					
Growing stock trees					
Sawlog					
Saw-log portion	285,436	181,849	2,242	82,173	19,172
Upper-stem portion	38,524	27,042	405	6,769	4,308
Total	323,960	208,891	2,647	88,942	23,480
Poletimber	108,354	64,024	2,724	17,960	23,646
All growing-stock trees	432,314	272,915	5,371	106,902	47,126
Cull trees					
Short-log trees	28,283	5,501	269	11,703	10,810
Rough trees [1]					
Sawtimber size	40,919	6,511	960	16,003	17,445
Poletimber size	41,772	7,194	2,292	12,722	19,564
Total	82,691	13,705	3,252	28,725	37,009
Rotten trees [1]					
Sawtimber size	11,691	268	125	8,521	2,777
Poletimber size	3,924	52	-	1,664	2,208
Total	15,615	320	125	10,185	4,985
All cull trees	126,589	19,526	3,646	50,613	52,804
All live trees	558,903	292,441	9,017	157,515	99,930
Salvable dead trees					
Sawtimber size	6,814	2,779	--	3,168	867
Poletimber size	1,563	158	--	683	722
All salvable dead trees	8,377	2,937	--	3,851	1,589
All classes	567,280	295,378	9,017	161,366	101,519

[1] Includes noncommercial species.

Table 18. -- Net volume of all live trees and growing-stock trees on timberland by ownership class and major species group, South Dakota outside the Black Hills National Forest, 1996

(In thousand cubic feet)

Ownership class	All live trees					Growing-stock trees				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	26,816	26,496	--	320	--	21,536	21,536	--	--	--
Other federal	11,091	6,144	--	4,578	369	9,707	5,989	--	3,554	164
State	46,128	44,113	--	946	1,069	43,467	42,721	--	257	489
County and municipal	3,044	--	--	3,044	--	2,924	--	--	2,924	--
Indian	82,376	36,681	569	28,767	16,359	62,694	33,801	23	21,411	7,459
Corporate	56,814	39,290	1,964	8,749	6,811	49,063	37,820	1,664	6,661	2,918
Individual	332,634	139,717	6,484	111,111	75,322	242,923	131,048	3,684	72,095	36,096
All ownerships	558,903	292,441	9,017	157,515	99,930	432,314	272,915	5,371	106,902	47,126

Table 19. -- Net volume of growing stock on timberland by forest type group/local type and major species group, South Dakota outside the Black Hills National Forest, 1996

(In thousand cubic feet)

Forest type group by local type	All species	Major species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
Softwood type groups					
Ponderosa pine					
Ponderosa pine	250,272	244,893	1,913	550	2,916
Total	250,272	244,893	1,913	550	2,916
Eastern redcedar					
Eastern redcedar	3,173	--	--	3,173	--
Eastern redcedar-hardwood	1,013	--	585	188	240
Total	4,186	--	585	3,361	240
Rocky Mountain juniper					
Rocky Mountain juniper	3,666	2,719	920	27	--
Total	3,666	2,719	920	27	--
All softwood types	258,124	247,612	3,418	3,938	3,156
Hardwood type groups					
Oak-hickory					
Bur oak	31,249	10,639	970	3,464	16,176
Total	31,249	10,639	970	3,464	16,176
Elm-ash-cottonwood					
Cottonwood	56,737	--	--	56,048	689
Elm-ash-soft maple	16,576	--	--	10,607	5,969
Willow	1,364	--	--	1,364	-
Total	74,677	--	--	68,019	6,658
Maple-beech-birch					
Maple-basswood	4,352	--	--	3,289	1,063
Total	4,352	--	--	3,289	1,063
Elm-ash-locust					
Elm-ash-locust	49,214	3,714	633	24,794	20,073
Total	49,214	3,714	633	24,794	20,073
Aspen-birch					
Aspen-birch	14,270	10,522	350	3,398	--
Total	14,270	10,522	350	3,398	--
All hardwood types	173,762	24,875	1,953	102,964	43,970
Nonstocked	428	428	--	--	--
All types	432,314	272,915	5,371	106,902	47,126

Table 20. -- Average annual net growth of growing stock and sawtimber on timberland by Forest Survey Unit and major species group, South Dakota outside the Black Hills National Forest, 1980-1995 [1]

Forest Survey Unit	Growing stock					Sawtimber				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	(In thousand cubic feet)					*(In thousand board feet)* [2]				
East	3,086	289	100	1,546	1,151	11,177	1,228	135	6,471	3,343
West	4,826	3,832	229	517	248	22,200	20,560	117	1,362	161
Total	7,912	4,121	329	2,063	1,399	33,377	21,788	252	7,833	3,504

[1] Average annual net growth as reported was computed for the period 1980-1995 in eastern South Dakota and for 1984-1995 in western South Dakota except the area inside the Black Hills National Forest.

[2] International 1/4-inch rule.

Table 21. -- Average annual removals of growing stock and sawtimber on timberland by Forest Survey Unit and major species group, South Dakota outside the Black Hills National Forest, 1980-1995 [1]

Forest Survey Unit	Growing stock					Sawtimber				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	(In thousand cubic feet)					*(In thousand board feet)* [2]				
East	1,152	--	7	566	579	3,980	--	4	2,042	1,934
West	65	5	--	35	25	156	--	--	156	--
Total	1,217	5	7	601	604	4,136	--	4	2,198	1,934

[1] Average annual removals as reported were computed for the period 1980-1995 in eastern South Dakota and for 1984-1995 in western South Dakota except the area inside the Black Hills National Forest.

[2] International 1/4-inch rule.

Table 22. -- Average annual net growth and average annual removals of growing stock and sawtimber on timberland by species group, South Dakota outside the Black Hills National Forest, 1980-1995 [1]

Species group	Growing stock		Sawtimber	
	Average annual net growth	Average annual removals	Average annual net growth	Average annual removals
Softwoods	*(In thousand cubic feet)*		*(In thousand board feet)* [2]	
Ponderosa pine	4,121	5	21,788	--
White spruce	51	--	108	--
Eastern redcedar	24	--	36	--
Other softwoods	254	7	108	4
Total	4,450	12	22,040	4
Hardwoods				
Select white oak	622	34	954	55
Basswood	103	3	413	15
Soft maple	90	26	481	131
Elm	158	170	199	483
White & green ash	734	488	2,494	1,598
Cottonwood	1,191	402	5,104	1,525
Willow	38	10	108	41
Hackberry	145	--	718	--
Quaking aspen	121	--	66	--
Paper birch	188	--	--	--
Black cherry	1	--	--	--
Other hardwoods	71	72	800	284
Total	3,462	1,205	11,337	4,132
All species	7,912	1,217	33,377	4,136

[1] Average annual net growth and average annual removals as reported were computed for the period 1980-1995 in eastern South Dakota and for 1984-1995 in western South Dakota except the area inside the Black Hills National Forest.

[2] International 1/4-inch rule.

Table 23. -- Average annual mortality of growing stock and sawtimber on timberland by species group, South Dakota outside the Black Hills National Forest, 1980-1995 [1]

Species group	Growing stock average annual mortality	Sawtimber average annual mortality
Softwoods	*(In thousand cubic feet)*	*(In thousand board feet)* [2]
Ponderosa pine	1,843	5,602
White spruce	10	39
Eastern redcedar	6	8
Other softwoods	8	32
Total	1,867	5,681
Hardwoods		
Select white oak	124	265
Basswood	56	127
Soft maple	86	400
Elm	570	1,135
White & green ash	340	401
Cottonwood	1,179	4,789
Willow	30	60
Hackberry	26	27
Quaking aspen	67	14
Paper birch	42	--
Other hardwoods	96	108
Total	2,616	7,326
All species	4,483	13,007

[1] Average annual mortality as reported was computed for the period 1980-1995 in eastern South Dakota and for 1984-1995 in western South Dakota except the area inside the Black Hills National Forest.

[2] International 1/4-inch rule.

Table 24. -- Average annual net growth and average annual removals of growing stock and sawtimber on timberland by ownership class and major species group, South Dakota outside the Black Hills National Forest, 1980-1995 [1]

Ownership class	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	Average annual net growth of growing stock				
		Major species group			
	(In thousand cubic feet)				
National forest	59	59	--	--	--
Other federal	144	55	--	89	--
State	617	599	22	-6	2
County and municipal	46	--	--	46	--
Indian	975	559	10	148	258
Corporate	972	613	48	243	68
Individual	5,099	2,236	249	1,543	1,071
All ownerships	7,912	4,121	329	2,063	1,399
	Average annual removals of growing stock				
		Major species group			
	(In thousand cubic feet)				
Indian	89	5	1	44	39
Individual	1,128	--	6	557	565
All ownerships	1,217	5	7	601	604
	Average annual net growth of sawtimber				
		Major species group			
	(In thousand board feet) [2]				
National forest	1,025	1,025	--	--	--
Other federal	268	268	--	--	--
State	2,756	2,783	--	-26	-1
County and municipal	218	--	--	218	--
Indian	3,037	2,375	3	256	403
Corporate	4,539	3,160	41	981	357
Individual	21,534	12,177	208	6,404	2,745
All ownerships	33,377	21,788	252	7,833	3,504
	Average annual removals of sawtimber				
		Major species group			
	(In thousand board feet) [2]				
Indian	256	--	4	198	54
Individual	3,880	--	--	2,000	1,880
All ownerships	4,136	--	4	2,198	1,934

[1] Average annual net growth and average annual removals as reported were computed for the period 1980-1995 in eastern South Dakota and for 1984-1995 in western South Dakota except the area inside the Black Hills National Forest.

[2] International 1/4-inch rule.

Table 25. -- Average annual net growth and average annual removals of growing stock and sawtimber on timberland by forest type group/local type and major species group, South Dakota outside the Black Hills National Forest, 1980-1995 [1]

Forest type group by local type	Average annual net growth of growing stock					Average annual removals of growing stock				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	(In thousand cubic feet)					*(In thousand cubic feet)*				
Softwood type groups										
Ponderosa pine										
Ponderosa pine	3,845	3,644	100	-1	102	5	5	--	--	--
Total	3,845	3,644	100	-1	102	5	5	--	--	--
Eastern redcedar										
Eastern redcedar	35	--	-3	38	--	--	--	--	--	--
Eastern redcedar-hardwood	36	--	14	1	21	--	--	--	--	--
Total	71	--	11	39	21	--	--	--	--	--
Rocky Mountain juniper										
Rocky Mountain juniper	203	69	131	2	1	1	--	1	--	--
Total	203	69	131	2	1	1	--	1	--	--
All softwood types	4,119	3,713	242	40	124	6	5	1	--	--
Hardwood type groups										
Oak-hickory										
Bur oak	885	200	31	122	532	24	--	--	--	24
Total	885	200	31	122	532	24	--	--	--	24
Elm-ash-cottonwood										
Cottonwood	1,016	--	--	1,015	1	319	--	--	319	--
Elm-ash-soft maple	394	--	--	246	148	263	--	--	56	207
Willow	107	--	--	107	--	--	--	--	--	--
Total	1,517	--	--	1,368	149	582	--	--	375	207
Maple-beech-birch										
Maple-basswood	72	--	--	61	11	--	--	--	--	--
Total	72	--	--	61	11	--	--	--	--	--
Elm-ash-locust										
Elm-ash-locust	843	58	40	162	583	605	--	6	226	373
Total	843	58	40	162	583	605	--	6	226	373
Aspen-birch										
Aspen-birch	462	136	16	310	--	--	--	--	--	--
Total	462	136	16	310	--	--	--	--	--	--
All hardwood types	3,779	394	87	2,023	1,275	1,211	--	6	601	604
Nonstocked	14	14	--	--	--	--	--	--	--	--
All types	7,912	4,121	329	2,063	1,399	1,217	5	7	601	604

Forest type group by local type	Average annual net growth of sawtimber					Average annual removals of sawtimber				
		Major species group					Major species group			
	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All species	Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	(In thousand board feet) [2]					*(In thousand board feet)* [2]				
Softwood type groups										
Ponderosa pine										
Ponderosa pine	19,603	19,503	75	4	21	--	--	--	--	--
Total	19,603	19,503	75	4	21	--	--	--	--	--
Eastern redcedar										
Eastern redcedar	202	--	--	202	--	--	--	--	--	--
Eastern redcedar-hardwood	-23	--	--	-25	2	--	--	--	--	--
Total	179	--	--	177	2	--	--	--	--	--
Rocky Mountain juniper										
Rocky Mountain juniper	440	426	12	2	--	4	--	4	--	--
Total	440	426	12	2	--	4	--	4	--	--
All softwood types	20,222	19,929	87	183	23	4	--	4	--	--
Hardwood type groups										
Oak-hickory										
Bur oak	1,833	897	57	246	633	41	--	--	--	41
Total	1,833	897	57	246	633	41	--	--	--	41
Elm-ash-cottonwood										
Cottonwood	4,796	--	--	4,834	-38	1,090	--	--	1,090	--
Elm-ash-soft maple	2,211	--	--	1,544	667	673	--	--	258	415
Willow	41	--	--	41	--	--	--	--	--	--
Total	7,048	--	--	6,419	629	1,763	--	--	1,348	415
Maple-beech-birch										
Maple-basswood	217	--	--	202	15	--	--	--	--	--
Total	217	--	--	202	15	--	--	--	--	--
Elm-ash-locust										
Elm-ash-locust	3,242	246	75	717	2,204	2,328	--	--	850	1,478
Total	3,242	246	75	717	2,204	2,328	--	--	850	1,478
Aspen-birch										
Aspen-birch	761	662	33	66	--	--	--	--	--	--
Total	761	662	33	66	--	--	--	--	--	--
All hardwood types	13,101	1,805	165	7,650	3,481	4,132	--	--	2,198	1,934
Nonstocked	54	54	--	--	--	--	--	--	--	--
All types	33,377	21,788	252	7,833	3,504	4,136	--	4	2,198	1,934

[1] Average annual net growth and average annual removals as reported were computed for the period 1980-1995 in eastern South Dakota and for 1984-1995 in western South Dakota except the area inside the Black Hills National Forest.

[2] International 1/4-inch rule.

Table 26. -- All live aboveground tree biomass on timberland by ownership class, major species group, and tree biomass component, South Dakota outside the Black Hills National Forest, 1996

(In green tons)

Ownership class and major species group	All components	Tree biomass component						
		All live 1-5 inch trees	Growing-stock trees			Non-growing-stock trees		
			Stumps	Boles	Tops and limbs	Stumps	Boles	Tops and limbs
National forest								
Pine	913,750	90,851	50,182	553,618	64,097	12,304	127,824	14,874
Soft hardwoods	12,953	--	--	--	--	675	10,118	2,160
Total	926,703	90,851	50,182	553,618	64,097	12,979	137,942	17,034
Other federal								
Pine	208,706	16,379	15,501	153,907	17,908	516	3,970	525
Other softwoods	159	159	--	--	--	--	--	--
Soft hardwoods	191,131	2,094	8,968	106,348	29,668	2,868	32,044	9,141
Hard hardwoods	20,001	2,419	593	5,000	1,880	891	6,519	2,699
Total	419,997	21,051	25,062	265,255	49,456	4,275	42,533	12,365
State								
Pine	1,529,558	162,318	99,047	1,097,702	124,211	3,977	37,741	4,562
Other softwoods	5,657	5,657	--	--	--	--	--	--
Soft hardwoods	42,310	5,373	572	6,424	2,089	1,610	20,321	5,921
Hard hardwoods	53,853	2,476	1,496	16,164	5,306	1,827	20,237	6,347
Total	1,631,378	175,824	101,115	1,120,290	131,606	7,414	78,299	16,830
County and municipal								
Soft hardwoods	117,527	--	5,505	87,406	18,136	365	4,906	1,209
Total	117,527	--	5,505	87,406	18,136	365	4,906	1,209
Indian								
Pine	1,208,717	75,072	77,014	868,815	97,040	7,562	74,397	8,817
Other softwoods	35,294	14,135	113	580	227	1,801	14,448	3,990
Soft hardwoods	1,195,385	54,679	48,955	625,640	149,706	21,291	228,378	66,736
Hard hardwoods	952,988	93,139	26,552	247,183	82,394	37,074	350,545	116,101
Total	3,392,384	237,025	152,634	1,742,218	329,367	67,728	667,768	195,644
Corporate								
Pine	1,278,151	64,697	85,321	971,852	109,586	4,168	37,903	4,624
Other softwoods	79,024	11,080	4,942	41,230	11,219	961	7,409	2,183
Soft hardwoods	472,329	86,924	21,389	201,444	63,694	7,267	70,559	21,052
Hard hardwoods	374,802	22,238	11,806	100,137	34,774	15,643	143,425	46,779
Total	2,204,306	184,939	123,458	1,314,663	219,273	28,039	259,296	74,638
Individual								
Pine	4,609,726	274,278	309,153	3,368,359	382,805	24,354	223,949	26,828
Other softwoods	404,809	167,899	13,850	91,124	28,982	10,855	69,923	22,176
Soft hardwoods	5,064,670	282,759	171,936	2,167,082	553,641	126,662	1,368,381	394,209
Hard hardwoods	3,962,107	279,182	111,757	1,158,885	374,733	140,337	1,446,700	450,513
Total	14,041,312	1,004,118	606,696	6,785,450	1,340,161	302,208	3,108,953	893,726
All ownerships								
Pine	9,748,608	683,595	636,218	7,014,253	795,647	52,881	505,784	60,230
Other softwoods	524,943	198,930	18,905	132,934	40,428	13,617	91,780	28,349
Soft hardwoods	7,096,305	431,829	257,325	3,194,344	816,934	160,738	1,734,707	500,428
Hard hardwoods	5,363,751	399,454	152,204	1,527,369	499,087	195,772	1,967,426	622,439
Total	22,733,607	1,713,808	1,064,652	11,868,900	2,152,096	423,008	4,299,697	1,211,446

Table 27. -- Area of land by land-use class, local forest type, and Forest Survey Unit, South Dakota outside the Black Hills National Forest, 1996

(In thousand acres)

Land-use class and local forest type	All Units	East	West
Forest land			
Timberland			
Ponderosa pine	290.1	14.6	275.5
Eastern redcedar	8.3	8.3	--
Eastern redcedar-hardwood	6.0	6.0	--
Rocky Mountain juniper	13.5	4.7	8.8
Bur oak	76.2	50.3	25.9
Cottonwood	35.6	27.5	8.1
Elm-ash-soft maple	18.6	17.4	1.2
Willow	5.4	5.4	--
Maple-basswood	5.1	5.1	--
Elm-ash-locust	82.2	73.8	8.4
Aspen-birch	23.0	--	23.0
Nonstocked	11.0	0.1	10.9
Total	575.0	213.2	361.8
Reserved timberland	12.2	1.1	11.1
Other forest land	77.0	28.8	48.2
All forest land	664.2	243.1	421.1
Nonforest land			
Nonforest with trees			
Cropland with trees	20.2	18.6	1.6
Improved pasture with trees	734.7	496.6	238.1
Wooded strips	95.0	75.6	19.4
Idle farmland with trees	12.2	12.2	--
Marsh with trees	5.4	5.2	0.2
Urban and other with trees	103.5	87.5	16.0
Windbreaks	110.4	106.1	4.3
Wooded pasture	182.4	144.0	38.4
Total	1,263.8	945.8	318.0
Nonforest without trees			
Cropland	16,786.0	15,200.1	1,585.9
Improved pasture	26,863.2	20,037.4	6,825.8
Idle farmland	907.2	466.8	440.4
Marsh	141.2	137.9	3.3
Other farm-farmstead	216.1	198.7	17.4
Urban and other	368.5	105.6	262.9
Noncensus water	155.5	130.3	25.2
Total	45,437.7	36,276.8	9,160.9
All nonforest land	46,701.5	37,222.6	9,478.9
Total land	47,365.7	37,465.7	9,900.0

Table 28. --Area of timberland by local forest type, stand-size class, and ownership class, South Dakota outside the Black Hills National Forest, 1996

(In thousand acres)

Local forest type and stand-size class	All ownerships	Ownership class						
		National forest	Other federal	State	County and municipal	Indian	Corporate	Individual
Ponderosa pine								
Sawtimber	145.5	12.4	4.0	18.5	--	19.9	16.3	74.4
Poletimber	67.8	--	--	7.6	--	9.3	9.2	41.7
Sapling & seedling	76.8	12.3	--	12.6	--	12.1	6.6	33.2
Total	290.1	24.7	4.0	38.7	--	41.3	32.1	149.3
Eastern redcedar								
Sawtimber	1.2	--	--	--	--	--	--	1.2
Sapling & seedling	7.1	--	--	1.0	--	--	--	6.1
Total	8.3	--	--	1.0	--	--	--	7.3
Eastern redcedar-hardwood								
Poletimber	2.8	--	--	--	--	--	--	2.8
Sapling & seedling	3.2	--	--	--	--	--	--	3.2
Total	6.0	--	--	--	--	--	--	6.0
Rocky Mountain juniper								
Poletimber	2.8	--	--	--	--	--	1.6	1.2
Sapling & seedling	10.7	--	0.2	2.4	--	1.4	--	6.7
Total	13.5	--	0.2	2.4	--	1.4	1.6	7.9
Bur oak								
Sawtimber	16.0	--	--	--	--	1.6	--	14.4
Poletimber	19.2	--	--	--	--	6.5	2.4	10.3
Sapling & seedling	41.0	--	--	5.1	--	13.1	2.1	20.7
Total	76.2	--	--	5.1	--	21.2	4.5	45.4
Cottonwood								
Sawtimber	32.0	--	2.4	--	1.2	4.2	4.7	19.5
Poletimber	2.5	--	--	--	--	2.5	--	--
Sapling & seedling	1.1	--	--	--	--	--	--	1.1
Total	35.6	--	2.4	--	1.2	6.7	4.7	20.6
Elm-ash-soft maple								
Sawtimber	8.4	--	--	--	--	0.6	--	7.8
Poletimber	4.4	--	1.1	--	--	0.9	--	2.4
Sapling & seedling	5.8	--	--	--	--	0.9	--	4.9
Total	18.6	--	1.1	--	--	2.4	--	15.1
Willow								
Sawtimber	2.1	--	--	--	--	2.1	--	--
Poletimber	3.3	--	--	--	--	--	--	3.3
Total	5.4	--	--	--	--	2.1	--	3.3
Maple-basswood								
Sawtimber	3.4	--	--	1.2	--	2.2	--	--
Poletimber	1.7	--	--	--	--	1.7	--	--
Total	5.1	--	--	1.2	--	3.9	--	--
Elm-ash-locust								
Sawtimber	29.9	--	--	--	--	3.7	0.7	25.5
Poletimber	23.0	--	--	--	--	2.6	2.1	18.3
Sapling & seedling	29.3	--	--	1.3	--	6.5	0.9	20.6
Total	82.2	--	--	1.3	--	12.8	3.7	64.4
Aspen-birch								
Sawtimber	0.4	--	--	--	--	--	--	0.4
Sapling & seedling	22.6	--	--	--	--	--	7.6	15.0
Total	23.0	--	--	--	--	--	7.6	15.4
Nonstocked	11.0	--	0.1	4.3	--	0.7	1.1	4.8
All types								
Sawtimber	238.9	12.4	6.4	19.7	1.2	34.3	21.7	143.2
Poletimber	127.5	--	1.1	7.6	--	23.5	15.3	80.0
Sapling & seedling	197.6	12.3	0.2	22.4	--	34.0	17.2	111.5
Nonstocked	11.0	--	0.1	4.3	--	0.7	1.1	4.8
Total	575.0	24.7	7.8	54.0	1.2	92.5	55.3	339.5

Table 29. -- Area of timberland by local forest type, stand-size class, and potential productivity class, South Dakota outside the Black Hills National Forest, 1996

(In thousand acres)

Local forest type and stand-size class	All classes	Potential productivity class (cubic feet of growth per acre per year)			
		120+	85-119	50-84	20-49
Ponderosa pine					
Sawtimber	145.5	--	3.7	28.0	113.8
Poletimber	67.8	--	--	2.4	65.4
Sapling & seedling	76.8	--	0.2	17.5	59.1
Total	290.1	--	3.9	47.9	238.3
Eastern redcedar					
Sawtimber	1.2	--	--	1.2	--
Sapling & seedling	7.1	--	--	2.6	4.5
Total	8.3	--	--	3.8	4.5
Eastern redcedar-hardwood					
Poletimber	2.8	0.9	--	--	1.9
Sapling & seedling	3.2	--	--	--	3.2
Total	6.0	0.9	--	--	5.1
Rocky Mountain juniper					
Poletimber	2.8	--	--	0.8	2.0
Sapling & seedling	10.7	--	--	1.3	9.4
Total	13.5	--	--	2.1	11.4
Bur oak					
Sawtimber	16.0	--	--	6.9	9.1
Poletimber	19.2	--	--	2.3	16.9
Sapling & seedling	41.0	--	--	3.9	37.1
Total	76.2	--	--	13.1	63.1
Cottonwood					
Sawtimber	32.0	--	1.3	8.6	22.1
Poletimber	2.5	--	--	--	2.5
Sapling & seedling	1.1	--	1.1	--	--
Total	35.6	--	2.4	8.6	24.6
Elm-ash-soft maple					
Sawtimber	8.4	--	--	6.7	1.7
Poletimber	4.4	--	--	0.3	4.1
Sapling & seedling	5.8	--	--	0.5	5.3
Total	18.6	--	--	7.5	11.1
Willow					
Sawtimber	2.1	--	--	--	2.1
Poletimber	3.3	--	3.3	--	--
Total	5.4	--	3.3	--	2.1
Maple-basswood					
Sawtimber	3.4	--	--	2.9	0.5
Poletimber	1.7	--	--	--	1.7
Total	5.1	--	--	2.9	2.2
Elm-ash-locust					
Sawtimber	29.9	--	--	7.1	22.8
Poletimber	23.0	--	--	10.0	13.0
Sapling & seedling	29.3	--	--	7.8	21.5
Total	82.2	--	--	24.9	57.3
Aspen-birch					
Sawtimber	0.4	--	--	--	0.4
Sapling & seedling	22.6	--	--	3.7	18.9
Total	23.0	--	--	3.7	19.3
Nonstocked	11.0	--	--	2.0	9.0
All types					
Sawtimber	238.9	--	5.0	61.4	172.5
Poletimber	127.5	0.9	3.3	15.8	107.5
Sapling & seedling	197.6	--	1.3	37.3	159.0
Nonstocked	11.0	--	--	2.0	9.0
Total	575.0	0.9	9.6	116.5	448.0

Table 30. -- Area of timberland by local forest type, stand-size class, and basal-area class, South Dakota outside the Black Hills National Forest, 1996

(In thousand acres)

Local fores type and stand-size class	All classes	Basal-area class (square feet per acre)													
		0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-120	121-150	151-180	181+
Ponderosa pine															
Sawtimber	145.5	0.4	2.8	4.6	8.1	10.8	13.3	6.4	21.1	19.0	21.7	15.6	16.2	--	5.5
Poletimber	67.8	0.5	0.6	4.9	--	5.5	8.1	3.6	8.9	5.7	1.6	7.4	11.2	9.8	--
Sapling & seedling	76.8	0.5	10.2	8.3	12.9	10.2	10.0	10.0	7.9	1.9	2.9	0.1	1.9	--	--
Total	290.1	1.4	13.6	17.8	21.0	26.5	31.4	20.0	37.9	26.6	26.2	23.1	29.3	9.8	5.5
Eastern redcedar															
Sawtimber	1.2	--	--	--	1.2	--	--	--	--	--	--	--	--	--	--
Sapling & seedling	7.1	1.0	2.6	--	--	--	--	--	--	3.5	--	--	--	--	--
Total	8.3	1.0	2.6	--	1.2	--	--	--	--	3.5	--	--	--	--	--
Eastern redcedar-hardwood															
Poletimber	2.8	--	--	--	--	0.6	--	--	0.9	--	1.3	--	--	--	--
Sapling & seedling	3.2	--	--	3.2	--	--	--	--	--	--	--	--	--	--	--
Total	6.0	--	--	3.2	--	0.6	--	--	0.9	--	1.3	--	--	--	--
Rocky Mountain juniper															
Poletimber	2.8	--	--	0.8	--	1.4	--	--	0.6	--	--	--	--	--	--
Sapling & seedling	10.7	--	0.2	0.7	--	2.4	--	--	1.7	2.1	--	3.6	--	--	--
Total	13.5	--	0.2	1.5	--	3.8	--	--	2.3	2.1	--	3.6	--	--	--
Bur oak															
Sawtimber	16.0	--	--	--	--	0.3	1.1	0.4	8.3	1.1	--	1.4	0.8	2.6	--
Poletimber	19.2	--	--	--	--	--	1.1	2.6	2.0	4.8	6.6	--	2.1	--	--
Sapling & seedling	41.0	8.8	6.2	3.9	1.0	8.9	1.5	7.1	1.4	1.7	--	0.5	--	--	--
Total	76.2	8.8	6.2	3.9	1.0	9.2	3.7	10.1	11.7	7.6	6.6	1.9	2.9	2.6	--
Cottonwood															
Sawtimber	32.0	0.2	1.3	--	2.3	6.5	--	3.0	3.5	5.6	3.7	0.3	3.3	1.5	0.8
Poletimber	2.5	--	--	--	2.5	--	--	--	--	--	--	--	--	--	--
Sapling & seedling	1.1	1.1	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	35.6	1.3	1.3	--	4.8	6.5	--	3.0	3.5	5.6	3.7	0.3	3.3	1.5	0.8
Elm-ash-soft maple															
Sawtimber	8.4	--	--	1.9	--	1.1	--	--	0.6	--	--	2.3	2.5	--	--
Poletimber	4.4	--	--	--	--	--	1.1	0.6	0.3	--	--	--	2.4	--	--
Sapling & seedling	5.8	1.7	2.0	0.4	0.5	--	--	--	--	--	--	1.2	--	--	--
Total	18.6	1.7	2.0	2.3	0.5	1.1	1.1	0.6	0.9	--	1.2	2.3	4.9	--	--
Willow															
Sawtimber	2.1	--	--	--	1.7	--	--	--	--	--	--	0.4	--	--	--
Poletimber	3.3	--	--	--	--	--	3.3	--	--	--	--	--	--	--	--
Total	5.4	--	--	--	1.7	--	3.3	--	--	--	--	0.4	--	--	--
Maple-basswood															
Sawtimber	3.4	--	--	--	--	--	--	1.7	--	--	--	1.2	--	0.5	--
Poletimber	1.7	--	--	--	--	--	--	--	--	--	--	1.7	--	--	--
Total	5.1	--	--	--	--	--	--	1.7	--	--	--	2.9	--	0.5	--
Elm-ash-locust															
Sawtimber	29.9	--	--	0.2	1.7	2.2	1.0	1.0	5.0	3.3	4.0	6.3	2.8	2.4	--
Poletimber	23.0	--	--	--	1.5	1.7	1.9	1.2	1.3	5.9	2.4	3.7	3.4	--	--
Sapling & seedling	29.3	8.1	1.1	7.4	6.2	3.1	0.9	2.3	0.2	--	--	--	--	--	--
Total	82.2	8.1	1.1	7.6	9.4	7.0	3.8	4.5	6.5	9.2	6.4	10.0	6.2	2.4	--
Aspen-birch															
Sawtimber	0.4	0.4	--	--	--	--	--	--	--	--	--	--	--	--	--
Sapling & seedling	22.6	--	2.1	2.0	2.1	5.5	3.3	--	3.7	1.8	--	2.1	--	--	--
Total	23.0	0.4	2.1	2.0	2.1	5.5	3.3	--	3.7	1.8	--	2.1	--	--	--
Nonstocked	11.0	8.2	2.8	--	--	--	--	--	--	--	--	--	--	--	--
All types															
Sawtimber	238.9	1.0	4.1	6.7	15.0	20.9	15.4	12.5	38.5	29.0	29.4	27.5	25.6	7.0	6.3
Poletimber	127.5	0.5	0.6	5.7	4.0	9.2	15.5	8.0	14.0	16.4	11.9	12.8	19.1	9.8	--
Sapling & seedling	197.6	21.2	24.4	25.9	22.7	30.1	15.7	19.4	14.9	11.0	4.1	6.3	1.9	--	--
Nonstocked	11.0	8.2	2.8	--	--	--	--	--	--	--	--	--	--	--	--
Total	575.0	30.9	31.9	38.3	41.7	60.2	46.6	39.9	67.4	56.4	45.4	46.6	46.6	16.8	6.3

Table 31. -- Net volume of all live trees [1] greater than 5 inches in diameter at breast height on timberland by species group and diameter class, South Dakota outside the Black Hills National Forest, 1996

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height)									
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods											
Ponderosa pine	292,441	28,277	42,993	51,369	47,411	41,514	29,907	23,791	14,556	12,623	--
White spruce	2,572	497	375	559	340	605	--	--	196	--	--
Eastern redcedar	2,282	214	1,067	574	427	--	--	--	--	--	--
Other softwoods	4,163	1,661	1,202	519	414	200	114	--	--	53	--
Total	301,458	30,649	45,637	53,021	48,592	42,319	30,021	23,791	14,752	12,676	--
Hardwoods											
Select white oak	61,561	7,817	9,762	9,443	8,514	5,704	5,706	5,128	3,641	4,100	1,746
Basswood	7,597	353	387	1,372	2,040	1,071	663	1,246	206	259	--
Soft maple	6,793	--	--	--	--	353	289	105	1,554	3,968	524
Elm	23,401	3,132	4,629	3,258	4,672	2,711	1,974	1,127	938	960	--
White & green ash	37,076	3,442	5,666	8,289	7,792	4,690	2,676	1,351	1,156	2,014	--
Cottonwood	89,512	603	2,509	1,633	3,093	5,174	9,596	7,637	3,674	29,327	26,266
Willow	2,478	60	79	310	285	1,103	394	115	--	132	--
Hackberry	3,857	444	607	1,181	877	615	--	133	--	--	--
Bigtooth aspen	258	--	--	--	--	258	--	--	--	--	--
Quaking aspen	4,432	1,134	1,948	584	446	320	--	--	--	--	--
Paper birch	1,523	891	423	209	--	--	--	--	--	--	--
Black cherry	166	75	--	--	--	--	--	--	--	91	--
Other hardwoods	14,878	1,918	1,656	2,441	3,337	1,645	678	1,388	519	915	381
Total	253,532	19,869	27,666	28,720	31,056	23,644	21,976	18,230	11,688	41,766	28,917
Noncommercial species	3,913	721	122	666	595	530	520	599	94	66	--
All species	558,903	51,239	73,425	82,407	80,243	66,493	52,517	42,620	26,534	54,508	28,917

1 Net volume of all live trees 5 inches d.b.h. and larger from 1-foot stump to a 4-inch top diameter outside bark.

Table 32. -- Net volume of tree species on timberland by individual species and major tree class, South Dakota outside the Black Hills National Forest, 1996

Individual species	Major tree class							
		All live trees					Saw-log size trees	
	All live trees	Growing stock	Short-log	Rough	Rotten	All saw-log size trees	Sawtimber	Short-log
	(In thousand cubic feet)					*(In thousand board feet)* [1]		
Softwoods								
Ponderosa pine	292,441	272,915	5,501	13,705	320	1,043,263	1,017,312	25,951
White spruce	2,572	2,041	--	531	--	6,808	6,808	--
Eastern redcedar	2,282	1,347	119	816	--	3,412	2,930	482
Rocky Mountain juniper	4,163	1,983	150	1,905	125	3,107	2,371	736
Total	301,458	278,286	5,770	16,957	445	1,056,590	1,029,421	27,169
Hardwoods								
White oak	1,374	476	489	409	--	3,963	1,832	2,131
Bur oak	60,187	21,993	8,393	28,708	1,093	82,819	46,890	35,929
American basswood	7,597	4,869	972	1,355	401	22,025	18,658	3,367
Silver maple	6,793	5,255	261	875	402	25,823	24,787	1,036
American elm	10,348	4,291	599	4,924	534	11,415	8,849	2,566
Siberian elm	9,212	3,649	1,615	3,332	616	15,741	8,907	6,834
Slippery elm	3,347	1,467	140	1,740	--	1,072	472	600
Rock elm	494	258	--	152	84	614	614	--
White ash	651	244	--	407	--	511	511	--
Green ash	36,425	23,853	1,928	6,836	3,808	66,525	58,795	7,730
Eastern cottonwood	89,512	77,068	6,171	2,058	4,215	375,652	354,597	21,055
Black willow	2,478	1,367	429	615	67	6,386	5,145	1,241
Hackberry	3,857	1,846	693	1,172	146	3,712	1,049	2,663
Bigtooth aspen	258	--	--	258	--	--	--	--
Quaking aspen	4,432	2,518	--	860	1,054	1,640	1,640	--
Paper birch	1,523	1,271	--	252	--	--	--	--
Black cherry	166	91	--	75	--	485	485	--
Boxelder	13,270	3,210	823	6,836	2,401	10,002	6,940	3,062
Honey locust	799	302	--	497	--	--	--	--
White mulberry	290	--	--	290	--	--	--	--
Red mulberry	519	--	--	357	162	--	--	--
Total	253,532	154,028	22,513	62,008	14,983	628,385	540,171	88,214
Noncommercial species	3,913	--	--	3,726	187	--	--	--
All species	558,903	432,314	28,283	82,691	15,615	1,684,975	1,569,592	115,383

[1] International 1/4-inch rule.

Table 33. -- Net volume of noncommercial tree species on timberland by individual species, South Dakota outside the Black Hills National Forest, 1996

(In thousand cubic feet)

Noncommercial tree species	Non-growing-stock volume
Eastern hophornbeam	105
Peachleaf willow	3,808
Total noncommercial species	3,913

Table 34. -- Net volume of growing stock on timberland by species group and local forest type, South Dakota outside the Black Hills National Forest, 1996

(In thousand cubic feet)

Species group	All types	Local forest type											
		Ponderosa pine	Eastern redcedar	Eastern redcedar-hardwood	Rocky Mountain juniper	Bur oak	Cottonwood	Elm-ash-soft maple	Willow	Maple-basswood	Elm-ash-locust	Aspen-birch	Nonstocked
Softwoods													
Ponderosa pine	272,915	244,893	--	--	2,719	10,639	--	--	--	--	3,714	10,522	428
White spruce	2,041	1,691	--	--	--	--	--	--	--	--	--	350	--
Eastern redcedar	1,347	--	--	585	--	380	--	--	--	--	382	--	--
Other softwoods	1,983	222	--	--	920	590	--	--	--	--	251	--	--
Total	278,286	246,806	--	585	3,639	11,609	--	--	--	--	4,347	10,872	428
Hardwoods													
Select white oak	22,469	2,807	--	240	--	13,873	--	35	--	410	5,104	--	--
Basswood	4,869	--	--	--	--	508	--	--	--	3,005	1,356	--	--
Soft maple	5,255	--	--	--	--	--	--	5,255	--	--	--	--	--
Elm	9,665	--	--	188	--	820	85	489	39	173	7,871	--	--
White & green ash	24,097	109	--	--	--	2,303	689	5,934	--	653	14,409	--	--
Cottonwood	77,068	159	3,173	--	--	1,402	55,963	3,371	1,051	--	11,949	--	--
Willow	1,367	--	--	--	--	132	--	674	274	--	287	--	--
Hackberry	1,846	--	--	--	--	397	--	406	--	--	1,043	--	--
Quaking aspen	2,518	208	--	--	--	--	--	--	--	--	--	2,310	--
Paper birch	1,271	183	--	--	--	--	--	--	--	--	--	1,088	--
Black cherry	91	--	--	--	--	--	--	91	--	--	--	--	--
Other hardwoods	3,512	--	--	--	27	205	--	321	--	111	2,848	--	--
Total	154,028	3,466	3,173	428	27	19,640	56,737	16,576	1,364	4,352	44,867	3,398	--
All species	432,314	250,272	3,173	1,013	3,666	31,249	56,737	16,576	1,364	4,352	49,214	14,270	428

Table 35. -- Net volume of sawtimber on timberland by species group and local forest type, South Dakota outside the Black Hills National Forest, 1996

(In thousand board feet) [1]

Species group	All types	Local forest type											
		Ponderosa pine	Eastern redcedar	Eastern redcedar-hardwood	Rocky Mountain juniper	Bur oak	Cottonwood	Elm-ash-soft maple	Willow	Maple-basswood	Elm-ash-locust	Aspen-birch	Nonstocked
Softwoods													
Ponderosa pine	1,017,312	890,803	--	--	11,904	49,070	--	--	--	--	16,693	46,833	2,009
White spruce	6,808	5,642	--	--	--	--	--	--	--	--	--	1,166	--
Eastern redcedar	2,930	--	--	1,177	--	615	--	--	--	--	1,138	--	--
Other softwoods	2,371	--	--	--	302	1,681	--	--	--	--	388	--	--
Total	1,029,421	896,445	--	1,177	12,206	51,366	--	--	--	--	18,219	47,999	2,009
Hardwoods													
Select white oak	48,722	1,590	--	879	--	28,980	--	--	--	799	16,474	--	--
Basswood	18,658	--	--	--	--	2,221	--	--	--	9,427	7,010	--	--
Soft maple	24,787	--	--	--	--	--	--	24,787	--	--	--	--	--
Elm	18,842	--	--	400	--	1,560	--	352	--	--	16,530	--	--
White & green ash	59,306	--	--	--	--	5,672	930	13,027	--	1,144	38,533	--	--
Cottonwood	354,597	678	14,346	--	--	6,954	261,441	16,915	--	--	54,263	--	--
Willow	5,145	--	--	--	--	624	--	2,480	774	--	1,267	--	--
Hackberry	1,049	--	--	--	--	99	--	--	--	--	950	--	--
Quaking aspen	1,640	--	--	--	--	--	--	--	--	--	--	1,640	--
Black cherry	485	--	--	--	--	--	--	485	--	--	--	--	--
Other hardwoods	6,940	--	--	--	--	922	--	613	--	455	4,950	--	--
Total	540,171	2,268	14,346	1,279	--	47,032	262,371	58,659	774	11,825	139,977	1,640	--
All species	1,569,592	898,713	14,346	2,456	12,206	98,398	262,371	58,659	774	11,825	158,196	49,639	2,009

[1] International 1/4-inch rule.

Table 36. -- Net volume of short-log trees (cull volume) in thousand cubic feet on timberland by species group and diameter class, South Dakota outside the Black Hills National Forest, 1996

Species group	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0+
Softwoods									
Ponderosa pine	5,501	2,350	1,745	1,222	52	--	132	--	--
Eastern redcedar	119	--	119	--	--	--	--	--	--
Other softwoods	150	89	--	61	--	--	--	--	--
Total	5,770	2,439	1,864	1,283	52	--	132	--	--
Hardwoods									
Select white oak	8,882	--	1,374	2,122	1,678	1,828	1,065	309	506
Basswood	972	--	332	112	141	387	--	--	--
Soft maple	261	--	--	--	87	--	174	--	--
Elm	2,354	--	477	484	910	335	148	--	--
White & green ash	1,928	--	816	629	75	206	--	202	--
Cottonwood	6,171	--	165	485	1,335	--	969	--	3,217
Willow	429	--	--	329	100	--	--	--	--
Hackberry	693	--	217	476	--	--	--	--	--
Other hardwoods	823	--	303	129	76	315	--	--	--
Total	22,513	--	3,684	4,766	4,402	3,071	2,356	511	3,723
All species	28,283	2,439	5,548	6,049	4,454	3,071	2,488	511	3,723

Table 37. -- Net volume of short-log trees (cull volume) in thousand board feet [1] on timberland by species group and diameter class, South Dakota outside the Black Hills National Forest, 1996

Species group	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0+
Softwoods									
Ponderosa pine	25,951	10,772	8,174	6,042	270	--	693	--	--
Eastern redcedar	482	--	482	--	--	--	--	--	--
Other softwoods	736	430	--	306	--	--	--	--	--
Total	27,169	11,202	8,656	6,348	270	--	693	--	--
Hardwoods									
Select white oak	38,060	--	5,715	8,964	7,161	7,913	4,669	1,364	2,274
Basswood	3,367	--	1,130	383	492	1,362	--	--	--
Soft maple	1,036	--	--	--	334	--	702	--	--
Elm	10,000	--	1,988	2,105	3,857	1,397	653	--	--
White & green ash	7,730	--	3,108	2,525	308	878	--	911	--
Cottonwood	21,055	--	507	1,546	4,265	--	3,477	--	11,260
Willow	1,241	--	--	920	321	--	--	--	--
Hackberry	2,663	--	800	1,863	--	--	--	--	--
Other hardwoods	3,062	--	1,079	481	289	1,213	--	--	--
Total	88,214	--	14,327	18,787	17,027	12,763	9,501	2,275	13,534
All species	115,383	11,202	22,983	25,135	17,297	12,763	10,194	2,275	13,534

[1] International 1/4-inch rule.

Table 38. -- Current annual net growth of growing stock and sawtimber on timberland, 1995, and average annual net growth of growing stock and sawtimber, 1980-1995, by Forest Survey Unit and softwoods and hardwoods, South Dakota outside the Black Hills National Forest [1]

Forest Survey Unit by softwoods and hardwoods	Growing stock		Sawtimber	
	Average annual net growth 1980-1995	Current annual net growth 1995	Average annual net growth 1980-1995	Current annual net growth 1995
	(In thousand cubic feet)		*(In thousand board feet)* [2]	
East				
Softwoods	389	381	1,363	1,442
Hardwoods	2,697	2,419	9,814	10,614
Total	3,086	2,800	11,177	12,056
West				
Softwoods	4,061	4,185	20,677	22,122
Hardwoods	765	827	1,523	1,576
Total	4,826	5,012	22,200	23,698
All Units				
Softwoods	4,450	4,566	22,040	23,564
Hardwoods	3,462	3,246	11,337	12,190
Total	7,912	7,812	33,377	35,754

[1] Average annual net growth as reported was computed for the period 1980-1995 in eastern South Dakota and for 1984-1995 in western South Dakota except the area inside the Black Hills National Forest.

[2] International 1/4-inch rule.

Table 39. -- Average annual net growth of growing stock on timberland by species group and local forest type, South Dakota outside the Black Hills National Forest, 1980-1995 [1]

(In thousand cubic feet)

Species group	All types	Local forest type											
		Ponderosa pine	Eastern redcedar	Eastern redcedar-hardwood	Rocky Mountain juniper	Bur oak	Cottonwood	Elm-ash-soft maple	Willow	Maple-basswood	Elm-ash-locust	Aspen-birch	Nonstocked
Softwoods													
Ponderosa pine	4,121	3,644	--	--	69	200	--	--	--	--	58	136	14
White spruce	51	35	--	--	--	--	--	--	--	--	--	16	--
Eastern redcedar	24	--	-3	14	--	7	--	--	--	--	6	--	--
Other softwoods	254	65	--	--	131	24	--	--	--	--	34	--	--
Total	4,450	3,744	-3	14	200	231	--	--	--	--	98	152	14
Hardwoods													
Select white oak	622	90	--	3	--	430	--	2	--	5	92	--	--
Basswood	103	--	--	--	--	18	--	--	--	60	25	--	--
Soft maple	90	--	--	--	--	--	--	90	--	--	--	--	--
Elm	158	-5	-8	1	--	31	14	12	1	-2	114	--	--
White & green ash	734	12	--	18	1	102	1	139	--	6	455	--	--
Cottonwood	1,191	5	46	--	1	25	1,006	74	89	--	-55	--	--
Willow	38	--	--	--	--	2	-5	20	17	--	4	--	--
Hackberry	145	--	--	--	--	37	--	48	--	--	60	--	--
Quaking aspen	121	-1	--	--	--	--	--	--	--	--	--	122	--
Paper birch	188	--	--	--	--	--	--	--	--	--	--	188	--
Black cherry	1	--	--	--	--	--	--	1	--	--	--	--	--
Other hardwoods	71	--	--	--	1	9	--	8	--	3	50	--	--
Total	3,462	101	38	22	3	654	1,016	394	107	72	745	310	--
All species	7,912	3,845	35	36	203	885	1,016	394	107	72	843	462	14

[1] Average annual net growth as reported was computed for the period 1980-1995 in eastern South Dakota and for 1984-1995 in western South Dakota except the area inside the Black Hills National Forest.

Table 40. -- Average annual net growth of sawtimber on timberland by species group and local forest type, South Dakota outside the Black Hills National Forest, 1980-1995 [1]

(In thousand board feet) [2]

Species group	All types	Local forest type											
		Ponderosa pine	Eastern redcedar	Eastern redcedar-hardwood	Rocky Mountain juniper	Bur oak	Cottonwood	Elm-ash-soft maple	Willow	Maple-basswood	Elm-ash-locust	Aspen-birch	Nonstocked
Softwoods													
Ponderosa pine	21,788	19,503	--	--	426	897	--	--	--	--	246	662	54
White spruce	108	75	--	--	--	--	--	--	--	--	--	33	--
Eastern redcedar	36	--	--	--	--	10	--	--	--	--	26	--	--
Other softwoods	108	--	--	--	12	47	--	--	--	--	49	--	--
Total	22,040	19,578	--	--	438	954	--	--	--	--	321	695	54
Hardwoods													
Select white oak	954	21	--	2	--	406	--	--	--	-4	529	--	--
Basswood	413	--	--	--	--	81	--	--	--	218	114	--	--
Soft maple	481	--	--	--	--	--	--	478	--	--	3	--	--
Elm	199	-20	-38	-25	--	-3	27	12	--	-28	274	--	--
White & green ash	2,494	--	--	--	--	227	-38	656	--	19	1,630	--	--
Cottonwood	5,104	24	240	--	2	111	4,807	308	--	--	-388	--	--
Willow	108	--	--	--	--	9	--	40	41	--	18	--	--
Hackberry	718	--	--	--	--	4	--	465	--	--	249	--	--
Quaking aspen	66	--	--	--	--	--	--	--	--	--	--	66	--
Other hardwoods	800	--	--	--	--	44	--	252	--	12	492	--	--
Total	11,337	25	202	-23	2	879	4,796	2,211	41	217	2,921	66	--
All species	33,377	19,603	202	-23	440	1,833	4,796	2,211	41	217	3,242	761	54

[1] Average annual net growth as reported was computed for the period 1980-1995 in eastern South Dakota and for 1984-1995 in western South Dakota except the area inside the Black Hills National Forest.

[2] International 1/4-inch rule.

Table 41. -- Current annual net growth of growing stock on timberland by species group and local forest type, South Dakota outside the Black Hills National Forest, 1995

(In thousand cubic feet)

Species group	All types	Local forest type											
		Ponderosa pine	Eastern redcedar	Eastern redcedar-hardwood	Rocky Mountain juniper	Bur oak	Cottonwood	Elm-ash-soft maple	Willow	Maple-basswood	Elm-ash-locust	Aspen-birch	Nonstocked
Softwoods													
Ponderosa pine	4,225	3,758	--	--	62	203	--	--	--	--	52	136	14
White spruce	51	35	--	--	--	--	--	--	--	--	--	16	--
Eastern redcedar	31	--	--	14	--	7	--	--	--	--	10	--	--
Other softwoods	259	77	--	--	130	24	--	--	--	--	28	--	--
Total	4,566	3,870	--	14	192	234	--	--	--	--	90	152	14
Hardwoods													
Select white oak	664	90	--	6	--	471	--	2	--	11	84	--	--
Basswood	108	--	--	--	--	18	--	--	--	64	26	--	--
Soft maple	83	--	--	--	--	--	--	83	--	--	--	--	--
Elm	174	--	--	3	--	33	4	7	1	4	122	--	--
White & green ash	760	29	--	18	--	93	18	139	--	10	453	--	--
Cottonwood	874	5	39	--	--	25	738	14	89	--	-36	--	--
Willow	41	--	--	--	--	-1	--	20	17	--	5	--	--
Hackberry	153	--	--	--	--	37	--	48	--	--	68	--	--
Quaking aspen	121	-1	--	--	--	--	--	--	--	--	--	122	--
Paper birch	188	--	--	--	--	--	--	--	--	--	--	188	--
Black cherry	1	--	--	--	--	--	--	1	--	--	--	--	--
Other hardwoods	79	--	--	--	1	5	--	7	-	3	63	--	--
Total	3,246	123	39	27	1	681	760	321	107	92	785	310	--
All species	7,812	3,993	39	41	193	915	760	321	107	92	875	462	14

Table 42. -- Current annual net growth of sawtimber on timberland by species group and local forest type, South Dakota outside the Black Hills National Forest, 1995

(In thousand board feet) [1]

Species group	All types	Local forest type											
		Ponderosa pine	Eastern redcedar	Eastern redcedar-hardwood	Rocky Mountain juniper	Bur oak	Cottonwood	Elm-ash-soft maple	Willow	Maple-basswood	Elm-ash-locust	Aspen-birch	Nonstocked
Softwoods													
Ponderosa pine	23,296	21,030	--	--	403	897	--	--	--	--	211	690	65
White spruce	108	75	--	--	--	--	--	--	--	--	--	33	--
Eastern redcedar	60	--	--	18	--	16	--	--	--	--	26	--	--
Other softwoods	100	--	--	--	36	54	--	--	--	--	10	--	--
Total	23,564	21,105	--	18	439	967	--	--	--	--	247	723	65
Hardwoods													
Select white oak	2,000	46	--	31	--	1,124	--	5	--	51	743	--	--
Basswood	684	--	--	--	--	81	--	--	--	419	184	--	--
Soft maple	470	--	--	--	--	--	--	441	--	--	29	--	--
Elm	-151	-5	--	-2	--	-10	--	-2	--	--	-132	--	--
White & green ash	2,731	--	--	--	--	156	-15	685	--	27	1,878	--	--
Cottonwood	4,555	24	294	--	--	152	4,008	49	--	--	28	--	--
Willow	193	--	--	--	--	-2	--	89	82	--	24	--	--
Hackberry	833	--	--	--	--	4	--	515	--	--	314	--	--
Quaking aspen	66	--	--	--	--	--	--	--	--	--	--	66	--
Black cherry	8	--	--	--	--	--	--	8	--	--	--	--	--
Other hardwoods	801	--	--	--	--	25	--	229	--	12	535	--	--
Total	12,190	65	294	29	--	1,530	3,993	2,019	82	509	3,603	66	--
All species	35,754	21,170	294	47	439	2,497	3,993	2,019	82	509	3,850	789	65

[1] International 1/4-inch rule.

Table 43. -- Current annual net growth and current annual mortality for 1995, and current annual removals for 1993, of growing stock and sawtimber on timberland by species group, South Dakota [1]

	Growing stock			Sawtimber		
Species group	Current annual net growth [2] 1995	Current annual mortality 1995	Current annual removals [3] 1993	Current annual net growth [2] 1995	Current annual mortality 1995	Current annual removals [3] 1993
	(In thousand cubic feet)			*(In thousand board feet)* [4]		
Softwoods						
Ponderosa pine	4,225	1,747	15,956	23,296	5,460	83,348
White spruce	51	10	65	108	39	318
Eastern redcedar	31	7	33	60	18	127
Other softwoods	259	2	--	100	10	1
Total	4,566	1,766	16,054	23,564	5,527	83,794
Hardwoods						
Select white oak	664	118	12	2,000	459	15
Basswood	108	60	--	684	165	--
Soft maple	83	95	--	470	454	--
Elm	174	612	36	-151	2,181	141
White & green ash	760	352	126	2,731	604	369
Cottonwood	874	1,292	788	4,555	6,353	2,378
Willow	41	34	--	193	164	--
Hackberry	153	32	--	833	49	--
Quaking aspen	121	67	384	66	14	399
Paper birch	188	42	--	--	--	--
Black cherry	1	--	--	8	2	--
Other hardwoods	79	101	19	801	197	44
Total	3,246	2,805	1,365	12,190	10,642	3,346
All species	7,812	4,571	17,419	35,754	16,169	87,140

[1] Current annual net growth and current annual mortality are for South Dakota except the Black Hills National Forest. Current annual removals are for South Dakota including the Black Hills National Forest.

[2] An estimate of current gross growth may be computed by adding current mortality to current net growth.

[3] Based on data from a 1993 mill survey, regional logging utilization factors, and land-use change estimates from the new inventory.

[4] International 1/4-inch rule.

Table 44. -- Current annual removals for 1993 and average annual removals for 1980-1995 of growing stock and sawtimber on timberland by Forest Survey Unit and softwoods and hardwoods, South Dakota [1]

Forest Survey Unit by softwoods and hardwoods	Growing stock		Sawtimber	
	Average annual removals [2]	Current annual removals [3]	Average annual removals [2]	Current annual removals [3]
	1980-1995	1993	1980-1995	1993
	(In thousand cubic feet)		*(In thousand board feet)* [4]	
East				
Softwoods	7	50	4	221
Hardwoods	1,145	689	3,976	2,891
Total	1,152	739	3,980	3,112
West				
Softwoods	5	16,004		83,573
Hardwoods	60	676	156	455
Total	65	16,680	156	84,028
All Units				
Softwoods	12	16,054	4	83,794
Hardwoods	1,205	1,365	4,132	3,346
Total	1,217	17,419	4,136	87,140

[1] Average annual removals are for South Dakota except the area inside the Black Hills National Forest and were computed for the period 1980-1995 in eastern South Dakota and for 1984-1995 in western South Dakota. Current annual removals are for South Dakota including the Black Hills National Forest.

[2] Average of field plot-level removals between the study periods.

[3] Based on data from a 1993 mill survey, regional logging utilization factors, and land-use change estimates from the new inventory.

[4] International 1/4-inch rule.

Table 45. -- Average annual mortality for 1980-1995 and current annual mortality for 1995 of growing stock and sawtimber on timberland by Forest Survey Unit and softwoods and hardwoods, South Dakota outside the Black Hills National Forest [1]

Forest Survey Unit by softwoods and hardwoods	Growing stock		Sawtimber	
	Average annual mortality 1980-1995	Current annual mortality 1995	Average annual mortality 1980-1995	Current annual mortality 1995
	(In thousand cubic feet)		*(In thousand board feet)* [2]	
East				
Softwoods	101	91	360	487
Hardwoods	2,277	2,470	6,426	9,589
Total	2,378	2,561	6,786	10,076
West				
Softwoods	1,766	1,675	5,321	5,040
Hardwoods	339	335	900	1,053
Total	2,105	2,010	6,221	6,093
All Units				
Softwoods	1,867	1,766	5,681	5,527
Hardwoods	2,616	2,805	7,326	10,642
Total	4,483	4,571	13,007	16,169

[1] Average annual mortality as reported was computed for the period 1980-1995 in eastern South Dakota and for 1984-1995 in western South Dakota except the area inside the Black Hills National Forest.

[2] International 1/4-inch rule.

Table 46. -- Current annual timber removals of growing stock and sawtimber on timberland by species group, product, logging residue, and other removals, South Dakota, 1993

Species group	Growing stock								Sawtimber						
		Removals for products (Items)					Nonproduct removals			Removals for products (Items)				Nonproduct removals	
	All removals	All product removals	Saw logs	Composite products [1]	Fuelwood	Posts, poles, and pilings	Logging residue	Other removals	All removals	All product removals	Saw logs	Composite products [1]	Fuelwood	Logging residue	Other removals
	(In thousand cubic feet)								*(In thousand board feet)* [2]						
Softwoods															
Ponderosa pine	15,956	13,311	12,574	670	51	16	1,019	1,626	83,348	77,301	76,384	788	129	1,127	4,920
White spruce	65	64	64	--	--	--	1	--	318	317	317	--	--	1	--
Eastern redcedar	33	4	4	--	--	--	--	29	127	18	18	--	--	1	108
Other softwoods	--	--	--	--	--	--	--	--	1	1	--	--	1	--	--
Total	16,054	13,379	12,642	670	51	16	1,020	1,655	83,794	77,637	76,719	788	130	1,129	5,028
Hardwoods															
Select white oak	12	2	--	--	2	--	1	9	15	5	--	--	5	--	10
Elm	36	19	6	--	13	--	1	16	141	66	29	--	37	4	71
White & green ash	126	9	2	--	7	--	--	117	369	30	12	--	18	1	338
Cottonwood	788	172	171	--	1	--	34	582	2,378	912	910	--	2	112	1,354
Quaking aspen	384	8	--	--	8	--	--	376	399	16	--	--	16	--	383
Other hardwoods	19	--	--	--	--	--	--	19	44	--	--	--	--	--	44
Total	1,365	210	179	--	31	--	36	1,119	3,346	1,029	951	--	78	117	2,200
All species	17,419	13,589	12,821	670	82	16	1,056	2,774	87,140	78,666	77,670	788	208	1,246	7,228

[1] Includes chip board, wafer board, particleboard, and engineered lumber.

[2] International 1/4-inch rule.

Table 47. -- Total volume of wood fiber used for each primary product by softwoods and hardwoods and source of material, South Dakota, 1993

Product by softwoods and hardwoods	Standard units	Total		Roundwood products				Plant byproducts [1]	
				Growing stock		Non-growing stock			
		Number of units	Thousand cubic feet [2]	Number of units	Thousand cubic feet	Number of units	Thousand cubic feet	Number of units	Thousand cubic feet
Saw logs									
Softwoods	Thousand	78,323	12,777	77,498	12,642	825	135	--	--
Hardwoods	board feet [3]	1,066	188	1,021	179	45	9	--	--
Total		79,389	12,965	78,519	12,821	870	144	--	--
Composite products [4]									
Softwoods	Standard	67,519	5,291	8,928	670	1,872	140	56,719	4,481
Total	cords	67,519	5,291	8,928	670	1,872	140	56,719	4,481
Fuelwood									
Softwoods	Standard	52,543	3,678	735	51	10,741	752	41,067	2,875
Hardwoods	cords	56,587	3,961	446	31	55,924	3,915	217	15
Total		109,130	7,639	1,181	82	66,665	4,667	41,284	2,890
Posts, poles, and pilings									
Softwoods	Thousand	21	21	16	16	5	5	--	--
Hardwoods	cubic feet	46	46	--	--	46	46	--	--
Total		67	67	16	16	51	51	--	--
Miscellaneous products									
Softwoods	Thousand	269	269	--	--	--	--	269	269
Hardwoods	cubic feet	2	2	--	--	--	--	2	2
Total		271	271	--	--	--	--	271	271
All products									
Softwoods	Thousand				13,379		1,032		7,625
Hardwoods	cubic feet				210		3,970		17
Total					13,589		5,002		7,642

[1] Includes coarse and fine wood residues.

[2] Column should not be added to avoid double counting volume.

[3] International 1/4-inch rule.

[4] Includes chip board, wafer board, particleboard, and engineered lumber.

Table 48. -- Output of roundwood products by product, softwoods and hardwoods, and source of material, South Dakota, 1993

(In thousand cubic feet)

Product by softwoods and hardwoods	All sources	Source of material			
		Growing stock			Non-growing stock
		Total	Sawtimber	Poletimber	
Saw logs					
Softwoods	12,777	12,642	12,515	127	135
Hardwoods	188	179	168	11	9
Total	12,965	12,821	12,683	138	144
Composite products [1]					
Softwoods	810	670	130	540	140
Total	810	670	130	540	140
Fuelwood					
Softwoods	803	51	30	21	752
Hardwoods	3,946	31	18	13	3,915
Total	4,749	82	48	34	4,667
Posts, poles, and pilings					
Softwoods	21	16	2	14	5
Hardwoods	46	--	--	--	46
Total	67	16	2	14	51
All products					
Softwoods	14,411	13,379	12,677	702	1,032
Hardwoods	4,180	210	186	24	3,970
Total	18,591	13,589	12,863	726	5,002

[1] Includes chip board, wafer board, particleboard, and engineered lumber.

Table 49. -- Timber products from roundwood by species group and product, South Dakota, 1993

Species group	All products	Product						
		Saw logs		Composite products [1]		Fuelwood		Posts, poles, and pilings
	(In thousand cubic feet)	*(In thousand board feet)* [2]	*(In thousand cubic feet)*	*(In standard cords)*	*(In thousand cubic feet)*	*(In standard cords)*	*(In thousand cubic feet)*	*(In thousand cubic feet)*
Softwoods								
Ponderosa pine	14,170	77,959	12,707	10,800	810	9,037	632	21
White spruce	66	344	66	--	--	--	--	--
Eastern redcedar	54	20	4	--	--	715	50	--
Other softwoods	121	--	--	--	--	1,724	121	--
Total	14,411	78,323	12,777	10,800	810	11,476	803	21
Hardwoods								
Select white oak	121	--	--	--	--	1,730	121	--
Soft maple	4	--	--	--	--	62	4	--
Elm	1,303	32	6	--	--	18,326	1,283	14
White & green ash	1,240	14	2	--	--	17,354	1,215	23
Cottonwood	1,245	1,020	180	--	--	15,096	1,056	9
Hackberry	77	--	--	--	--	1,100	77	--
Quaking aspen	115	--	--	--	--	1,636	115	--
Black walnut	13	--	--	--	--	186	13	--
Other hardwoods	41	--	--	--	--	580	41	--
Total	4,159	1,066	188	--	--	56,070	3,925	46
Noncommercial species	21	--	--	--	--	300	21	--
All species	18,591	79,389	12,965	10,800	810	67,846	4,749	67

[1] Includes chip board, wafer board, particleboard, and engineered lumber.

[2] International 1/4-inch rule.

Table 50. -- All live tree biomass on timberland by species group and local forest type, South Dakota outside the Black Hills National Forest, 1996

(In green tons)

Species group	All types	Local forest type											
		Ponderosa pine	Eastern redcedar	Eastern redcedar-hardwood	Rocky Mountain juniper	Bur oak	Cottonwood	Elm-ash-soft maple	Willow	Maple-basswood	Elm-ash-locust	Aspen-birch	Nonstocked
Softwoods													
Ponderosa pine	9,748,608	8,831,281	--	--	98,811	350,419	--	--	--	--	119,013	331,612	17,472
White spruce	93,746	78,169	--	--	--	--	--	--	--	--	--	15,577	--
Eastern redcedar	137,118	--	42,397	44,910	--	27,027	--	--	--	--	22,784	--	--
Other softwoods	294,079	43,379	--	--	188,922	31,657	--	1,062	--	--	29,059	--	--
Total	10,273,551	8,952,829	42,397	44,910	287,733	409,103	--	1,062	--	--	170,856	347,189	17,472
Hardwoods													
Select white oak	3,336,238	326,538	5,869	61,064	809	2,387,842	--	5,036	--	53,743	489,885	5,452	--
Basswood	281,142	--	--	--	--	29,707	--	--	--	173,139	78,296	--	--
Soft maple	291,831	--	--	--	--	--	520	231,564	--	--	59,747	--	--
Elm	1,276,422	6,457	7,900	34,347	269	139,643	10,823	76,458	6,582	23,770	970,173	--	--
White & green ash	1,966,489	15,877	--	10,588	938	225,795	87,037	416,425	1,317	52,610	1,155,902	--	--
Cottonwood	3,590,840	11,152	217,683	--	--	75,493	2,620,682	133,144	50,833	--	481,853	--	--
Willow	102,482	--	--	--	--	4,819	--	48,549	38,139	--	10,975	--	--
Hackberry	198,080	--	--	--	--	41,314	--	49,328	--	--	107,438	--	--
Bigtooth aspen	10,387	--	--	--	--	--	10,387	--	--	--	--	--	--
Quaking aspen	241,086	56,225	--	--	--	8,868	--	--	--	--	--	175,993	--
Paper birch	147,330	45,005	--	--	--	--	--	--	--	--	--	102,325	--
Black cherry	6,555	--	--	--	--	--	--	3,167	--	--	3,388	--	--
Other hardwoods	751,127	5,251	--	22,371	1,194	24,638	23,573	104,484	1,399	17,511	549,629	1,077	--
Total	12,200,009	466,505	231,452	128,370	3,210	2,938,119	2,753,022	1,068,155	98,270	320,773	3,907,286	284,847	--
Noncommercial species	260,047	15,708	--	950	33	23,562	52,274	38,591	67,665	14,515	31,052	15,697	--
All species	22,733,607	9,435,042	273,849	174,230	290,976	3,370,784	2,805,296	1,107,808	165,935	335,288	4,109,194	647,733	17,472

Table 51. -- All live tree biomass on timberland by species group and tree biomass component, South Dakota outside the Black Hills National Forest, 1996

(In green tons)

Species group	All components	Tree biomass component						
		All live 1-5-inch trees	Growing-stock trees			Non-growing-stock trees		
			Stumps	Boles	Tops and limbs	Stumps	Boles	Tops and limbs
Softwoods								
Ponderosa pine	9,748,608	683,595	636,218	7,014,253	795,647	52,881	505,784	60,230
White spruce	93,746	2,569	6,318	51,020	13,718	2,222	13,292	4,607
Eastern redcedar	137,118	58,295	3,962	32,427	9,907	2,663	23,044	6,820
Other softwoods	294,079	138,066	8,625	49,487	16,803	8,732	55,444	16,922
Total	10,273,551	882,525	655,123	7,147,187	836,075	66,498	597,564	88,579
Hardwoods								
Select white oak	3,336,238	224,338	85,533	779,312	258,148	143,093	1,409,344	436,470
Basswood	281,142	5,243	10,642	121,746	37,030	6,734	76,345	23,402
Soft maple	291,831	755	9,009	168,825	39,727	2,957	58,026	12,532
Elm	1,276,422	166,234	38,950	306,008	103,865	53,261	460,558	147,546
White & green ash	1,966,489	175,116	64,509	731,665	234,823	49,377	534,303	176,696
Cottonwood	3,590,840	12,825	166,018	2,306,023	539,500	31,115	433,371	101,988
Willow	102,482	713	3,769	38,792	11,247	3,685	33,946	10,330
Hackberry	198,080	20,525	7,773	56,080	20,227	7,343	65,657	20,475
Bigtooth aspen	10,387	--	--	--	--	471	8,159	1,757
Quaking aspen	241,086	33,728	6,900	74,777	21,456	6,955	75,711	21,559
Paper birch	147,330	71,373	5,984	40,440	16,908	980	8,505	3,140
Black cherry	6,555	--	157	2,461	549	313	2,170	905
Other hardwoods	751,127	35,967	10,285	95,584	32,541	38,125	412,619	126,006
Total	12,200,009	746,817	409,529	4,721,713	1,316,021	344,409	3,578,714	1,082,806
Noncommercial species	260,047	84,466	--	--	--	12,101	123,419	40,061
All species	22,733,607	1,713,808	1,064,652	11,868,900	2,152,096	423,008	4,299,697	1,211,446

Table 52. -- Sampling errors [1] for Forest Survey Units and River Basins for area of timberland, volume, average annual net growth, and average annual removals of growing stock and sawtimber on timberland, South Dakota outside the Black Hills National Forest, 1996

(Sampling error in percent)

		Growing stock			Sawtimber		
Forest Survey Unit	Area	Volume	Average annual net growth	Average annual removals	Volume	Average annual net growth	Average annual removals
East	7.6	5.2	10.3	28.7	8.5	12.1	25.3
West	4.1	5.8	11.4	31.7	9.4	13.4	28.0
Total	3.8	4.2	8.0	27.2	6.8	9.8	24.4
River Basin							
Belle Fourche-Grand-Moreau [2]	8.0	7.8			12.0		
Cheyenne [3]	6.3	7.1			11.9		
White-Niobrara [4]	9.3	10.9			16.8		
Bad-Missouri-Coteau-James [5]	10.3	14.2			25.0		
Minnesota-Big Sioux-Coteau [6]	12.0	11.6			18.9		

[1] Sampling error is not calculated when the estimate is equal to 0.

[2] Belle Fourche-Grand-Moreau includes Butte, Corson, Dewey, Harding, Lawrence, and Perkins Counties.

[3] Cheyenne includes Custer, Fall River, Haakon, Meade, Pennington, and Ziebach Counties.

[4] White-Niobrara includes Bennett, Jackson, Mellette, Shannon, Todd, and Tripp Counties.

[5] Bad-Missouri-Coteau-James includes Aurora, Beadle, Bon Homme, Brown, Brule, Buffalo, Campbell, Charles Mix, Davison, Douglas, Edmunds, Faulk, Gregory, Hand, Hanson, Hughes, Hutchinson, Hyde, Jerauld, Jones, Lyman, McPherson, Miner, Potter, Sanborn, Spink, Stanley, Sully, Walworth, and Yankton Counties.

[6] Minnesota-Big Sioux-Coteau includes Brookings, Clark, Clay, Codington, Day, Deuel, Grant, Hamlin, Kingsbury, Lake, Lincoln, Marshall, McCook, Minnehaha, Moody, Roberts, Turner, and Union Counties.

Table 53. -- Area of timberland by forest type group/local forest type and stand-size class, South Dakota including the Black Hills National Forest, 1996

(In thousand acres)

Forest type group/ local forest type	All stands	Stand-size class			
		Sawtimber	Poletimber	Sapling & seedling	Nonstocked
Ponderosa pine					
Ponderosa pine	1,157.9	740.1	306.3	111.5	--
Total	1,157.9	740.1	306.3	111.5	--
Other pines					
Scotch pine	1.4	--	1.4	--	--
Total	1.4	--	1.4	--	--
Spruce-fir					
White spruce	21.3	19.0	1.8	0.5	--
Total	21.3	19.0	1.8	0.5	--
Eastern redcedar					
Eastern redcedar	8.3	1.2	--	7.1	--
Eastern redcedar-hardwood	6.0	--	2.8	3.2	--
Total	14.3	1.2	2.8	10.3	--
Rocky Mountain juniper					
Rocky Mountain juniper	13.5	--	2.8	10.7	--
Total	13.5	--	2.8	10.7	--
Oak-hickory					
Bur oak	79.9	17.2	21.0	41.7	--
Total	79.9	17.2	21.0	41.7	--
Elm-ash-cottonwood					
Cottonwood	35.6	32.0	2.5	1.1	--
Elm-ash-soft maple	18.6	8.4	4.4	5.8	--
Willow	5.4	2.1	3.3	--	--
Total	59.6	42.5	10.2	6.9	--
Maple-beech-birch					
Maple-basswood	5.1	3.4	1.7	--	--
Total	5.1	3.4	1.7	--	--
Elm-ash-locust					
Elm-ash-locust	80.8	29.9	21.6	29.3	--
Total	80.8	29.9	21.6	29.3	--
Aspen-birch					
Aspen-birch	57.9	7.4	20.7	29.8	--
Total	57.9	7.4	20.7	29.8	--
Nonstocked	32.7	--	--	--	32.7
All types	1,524.4	860.7	390.3	240.7	32.7

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Reports findings of the comprehensive survey of South Dakota's 664.2 thousand acres of forests outside the Black Hills National Forest. This report contains detailed tables related to the extent, composition, and causes of change of South Dakota's forests.

KEY WORDS: Forest area, timber volume, growth, removals, mortality.

Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.